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SCCS INTERFACE

VOL. 1 ISSUE 5 APRIL 1976

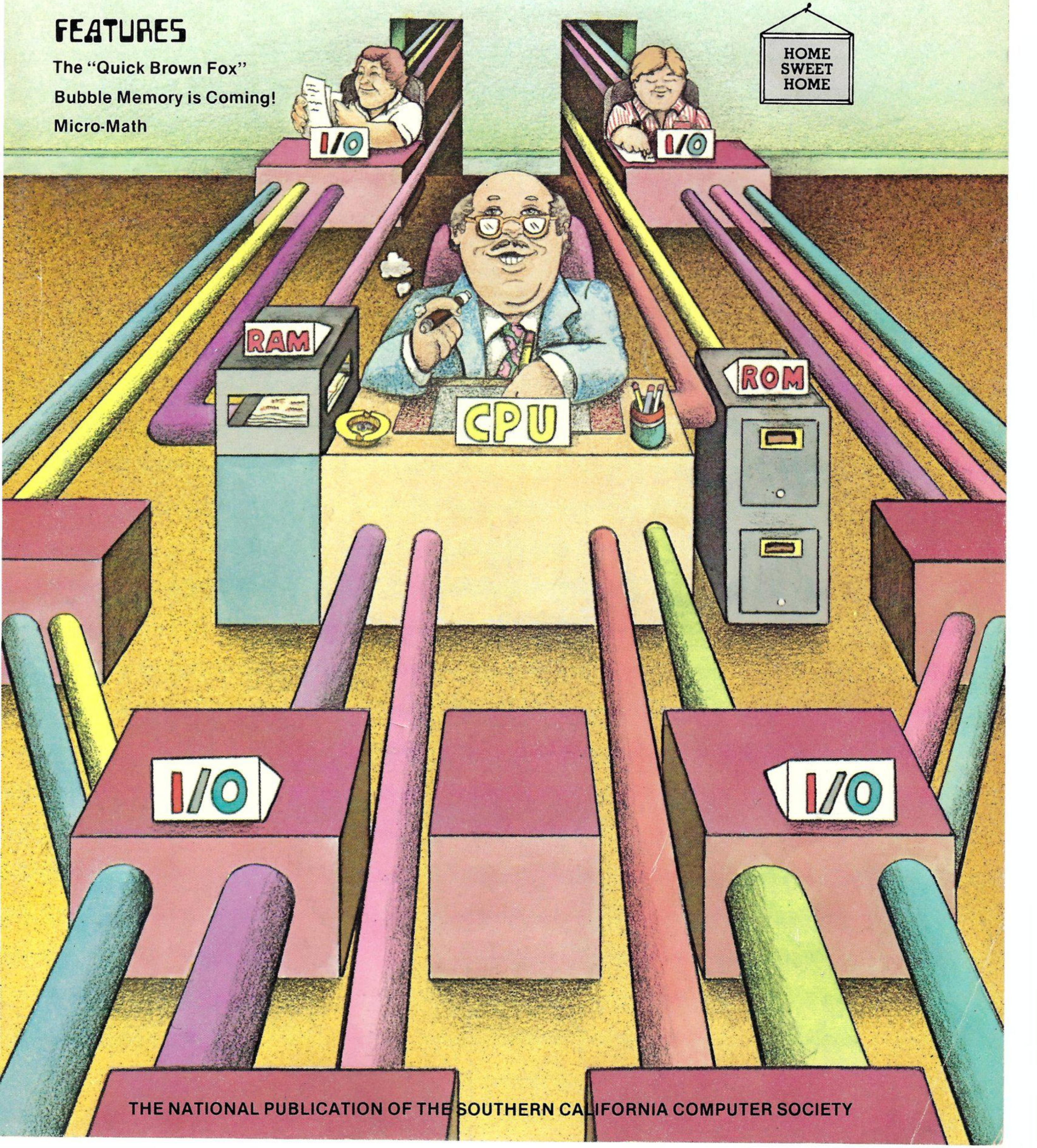
PUBLISHED FOR THE HOME COMPUTERIST

FEATURES

The "Quick Brown Fox"

Bubble Memory is Coming!

Micro-Math


HOME
SWEET
HOME
I/O
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RAM
ROM
CPU
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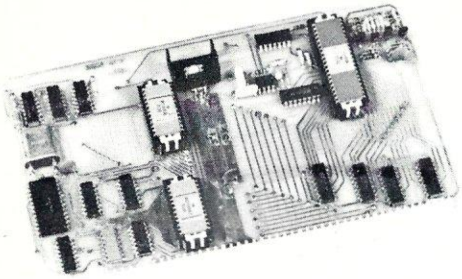
I/O

THE NATIONAL PUBLICATION OF THE SOUTHERN CALIFORNIA COMPUTER SOCIETY

IT ADDS UP-



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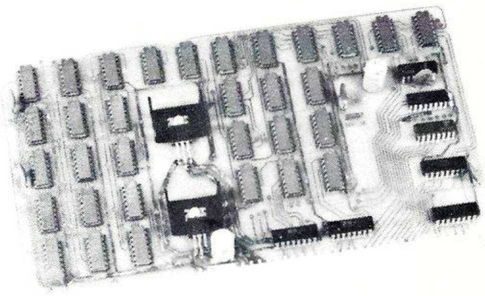

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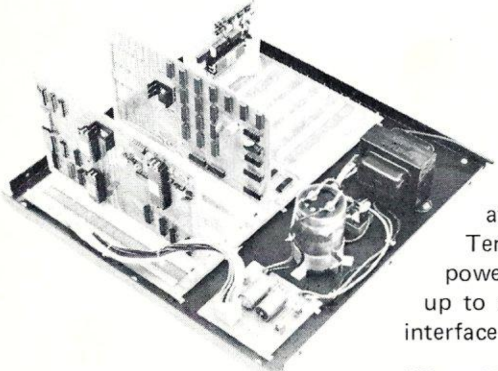

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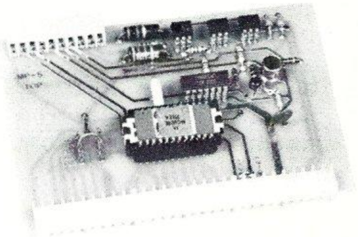

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SCCS INTERFACE

The National Publication of the Southern California Computer Society

Vol. 1 Issue 5 APRIL 1976

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OBJECTIVES AND PUBLICATIONS

A non-profit organization whose purpose is:

A. To exchange and disseminate information among the Society members concerning the computer arts and sciences.

B. To provide a technical assistance to other members of the Society in those computer projects which are not undertaken for pecuniary gain or profit including but not limited to hardware, software, and computer programming.

C. To publish books, newsletters, magazines, and other periodicals for the benefit and education of the Society members and the general public.

D. To control and sponsor seminars, lectures, and courses relating to the computer arts and sciences.

F. To develop and maintain computer centers and laboratory workshops for the members of the Society and the general public including provisions for time-sharing operations.

SCCS INTERFACE, the official publication of the Southern California Computer Society is published monthly. Its content is composed primarily of articles contributed by members of the Society and intended for the reader with an interest in computers for professional or avocational reasons.

MEMBERSHIP

Membership in the Society is open to anyone, regardless of educational background or geographic location. All members are entitled to the rights of meetings, elections, receipt of official publications in a timely manner, and all other benefits as provided by the officers, Board of Directors, and various committees of the Society pursuant to the by-laws of the Southern California Computer Society.

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Scott Wilcox, Hardware Editor
Nancy DeLong, Associate Editor
Tom Rugg, Games Editor
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They must be accompanied by return postage and we assume no responsibility for loss or damage thereto. Any material accepted is subject to such revision as is necessary in our sole discretion to meet the requirements of this publication. The act of mailing a manuscript and/or material shall constitute an express warranty by the contributor that the material is original and in no way an infringement upon the rights of others. Send all contributions to: Art Childs—Editor, 335 North Adams, Suite 210, Glendale, Ca. 91206.

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PUBLISHERS STATEMENT

All editorial content and effort are contributed at no cost to the Society. Opinions expressed in by-lined articles do not necessarily reflect the opinion of this magazine or the Southern California Computer Society. Mention of products by trade name in editorial material or advertisements contained herein in no way constitutes an endorsement of the product or products by this magazine or by the Southern California Computer Society.

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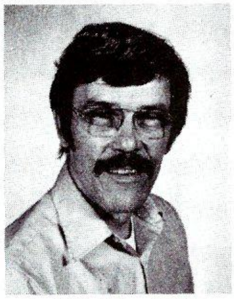
Art Childs, Editor

Photo by George R. Clarke

INTERFACIAL

IN THIS ISSUE

A few months ago at one of the first SCCS general meetings, Ted Wirtz presented a fascinating talk on bubble memory. Since that day, vague dreams of random access megabyte storage capability have haunted many of us. Read Ted's article *"Bubble Memory is Coming"* and dream along with us.

William Peterson, in the latest of his series on *"Calculatin' Engines"* provides some fascinating background on some of our conventions. He illustrates, as most computer buffs have long suspected, that should man have had eight, rather than ten fingers, all this controversy over hex, decimal, and octal would probably have never occurred.

The arts (for computers) are well represented in this issue. John Whitney, still searching for a way to get the artist and the computer buff to collaborate expresses more thoughts on the subject in *"Back to Baroque by way of the Dim Cultural Savage."* And Valley Chapter member Graham Mahin, assuring that we writers must also face the possibility of replacement by a computer, has contributed a program which writes stories, "Quick Brown Fox" Random Short Story Generator. (Perhaps that's what happened to the TTY on the front cover—it wrote a dirty story.)

Terry Benson, to whom we owe our apologies for misspelling his name in the February issue, presents the first part of *"Serial Data Communication"* in his series on Micro-Computer Applications. We're happy his feelings weren't too badly hurt by our mistake since the information he imparts is valuable for the serious programmer.

Larry Press, in his column *"Applications Exchange,"* makes his urgent plea for someone to show both him and the editor which end of the soldering iron to use via tutorials designed to teach software types the ins and outs of the hardware game. Larry has also started what could become the answer to our prayers—a list of people with special software interest to whom eager members might write for programs and advice. (Hopefully the efforts of these people will culminate in the formalization of the SCCS Software Exchange.)

In the games department, Tom Rugg gives more detail on random number generators. Mike Stern's schedule became too crowded and so has put "Games 'N Things" in Tom's capable hands. Tom also has some interesting news for the Trekkies and invites all you game buffs to submit your favorite.

Spurred on by wide acceptance to his series, Cliff Sparks is still plugging away at "Teletype Maintenance and Repair."

Scott Wilcox, in "Memory Expansion" shows us an inexpensive way to double our memory capacity, and Bruce Scott invites you to work on your mental capacity in "Micro Math."

This issue carries a new department—"Up 'n Runnin'," edited by Stephen Tuenge. The goal of this experimental department is to collect all the hardware troubles experienced by members, and print the most common. Besides helping reduce the possibility of having to re-invent the wheel, it is hoped the information presented will be educational and interesting. All who have had hardware troubles are invited to submit the details for compilation and, as a result, give the next person a helping hand.

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UPdate

APRIL MEETING: Saturday, April 24th

Due to our continuing growth, TRW Systems, our fine hosts in the past, can no longer accommodate our monthly meetings. Although plans are in progress for larger facilities, at this writing a definite location has not been set. The April meeting will be held at the Roger Young Auditorium, 936 Washington Blvd., Los Angeles. Doors open at 10:00 a.m. (Intersection of Santa Monica and Harbor Frwys.) BOARD MEETING: Wednesday, April 14th, 7:30 p.m.

Board Meetings are open to all interested members. If you'd like to attend contact one of the board members for the exact location.

MAY MEETING: Saturday, May 22nd

The May meeting promises a special day. A joint meeting is planned with SCCS members and the Academy of Motion Picture Arts & Sciences. Computer generated motion pictures and graphics will be the topic, featuring John Whitney's "Arabesque." Seating must be reserved in advance with ticketed reservations. For more information and reservations, contact Lou Fields by writing 11662 Sunset Blvd., Los Angeles 90049, or call (213) 472-0388 or (213) 727-0942. More detail will appear in the May issue of INTERFACE.

FEBRUARY MEETING

The SCCS general meeting in February attracted over 600 members and visitors, and took more than 50 new members into the fold. Exhibitors displayed their wares in a special room separate from the general meeting and drew a large number of members. During the meeting the NBC news crew was discreetly taping for their evening news. Looks like we made the big time!

The membership heard "Introduction to Basic" delivered by Frank Tendick. Frank is a student at Santa Monica High School *and* UCLA, an SCCS charter member, an Explorer, and an Altair Owner. Are they keeping you busy enough, Frank?

Hamilton/Avent's PR rep, Richard O'Melveny introduced the membership to his organization and its relationship to the minicomputer enthusiast with its new Microprocessor Development Center.

Door prizes valuing $275 were contributed: EDWARDS ASSOCIATES: "Introduction to Microcomputers," Logic Probe, SK-10 sockets, Clip-a-Dip, and Bug Books. OLIVER AUDIO ENGINEERING: OP80A Paper Tape Reader Kit. COMPUTER MART: Proto Board, Vector Wiring Pen. HAMILTON/AVNET: 8080 Book, Pace Book. DEL REY COMPUTER: Logic Probe. I.C. ELECTRONIC SUPPLY: Micro-computer Dictionary. ELLIAM ASSOCIATES: TTY Bond Paper Roll. SARGENT'S DISTRIBUTION: Wire Wrap Proto Board, Wire Pen. Other prizes included a 12" Crescent and 8" Crescent wrench, set of screwdrivers, soap from China, digital clock chip, and a Sears Multiband Radio. Not a bad reason to stay for the duration.

CALENDAR

You may want to mark your calendar with meeting schedules for the balance of 1976.

Regular Meeting	*Board of Directors Meeting*
April 24	April 14
May22	May 12
June 26	June 16
July 24	July 14
August 21	August 11
September 25	September 15
October 23	October 13
November 20	November 10
December 18	December 8

SCCS CHAPTER NEWS

SOUTHERN NEW ENGLAND CHAPTER FORMING

SCCS members and other computer enthusiasts living in New Haven, Connecticut and surrounding area will be interested in contacting Charles Floto about the proposed Southern New England Chapter. Mr. Floto, a new SCCS member, may be contacted by calling (203) 562-4739, or write 267 Willow St., "I," New Haven, Ct. 06511

ANYONE FOR A NORTH JERSEY CHAPTER?

Bruce C. Dalland is interested in that possibility and would appreciate hearing from others in his area. Write him at 37 Brook Dr., Dover 07801.

WIN A TI7400! Join the San Gabriel Valley Chapter of SCCS and come up with a shorter name. For information, send a stamped self-addressed envelope to Dan Erickson, 400 S. Cataline Ave., Pasadena 91106, or Michael Naber, 66 S. Grand Oaks, #6, Pasadena 91107.

SOUTH EAST COMPUTER GROUP

Announced regular meetings to be held the first Thursday of every month at the South Gate Public Library, 4035 Tweedy from 6:30 to 9:00 p.m. For information call (213) 566-1677.

SAN FERNANDO VALLEY CHAPTER
SCCS's FIRST

The Valley Chapter of the SCCS held its first program meeting on Wednesday, February 4, at the Harvard School. More than 150 people came out in the rain to show their interest.

It was reported that an earlier organizational meeting on January 7, attended by 30-40, had decided to set up a pro-tem organization to get the chapter on its feet.

The pro-tem officers would serve for a period of approximately 90 days, at which time the members would select their leaders. The pro-tem officers selected were John Scott, Chairman; David Resnick, Co-Chairman; Al Herndon, Treasurer; Stuart Gibbs, Secretary; Gene Murrow, Program Chairman; Jerry Silver, Board of Directors; and Alan Hussey, Delegate to main SCCS Board of Directors.

The purpose of the Valley group is to provide a medium (especially for Valley people) to give greater visibility to individuals through a smaller group, and increase the ability of individuals to match up their specific needs in a setting more manageable by its size.

A spirited RAM session (although tame by comparison to the parent organization) was very fruitful, and resulted in a number of ideas for the future and individual match-ups. After the RAM session, the organized program offered sessions as follows:

1. BASIC Computer Language, an introduction and demonstration led by Jerry Silver.
2. Hardware and Machine Language Programming, led by Gene Murrow. Ideas coming out of this session included possible forming of a Valley Altair User's Group, generation of a central software library, and creation of a computer building group, with possible design classes.
3. Altair Demonstration, led by Jon Walden.

The next meeting of the Valley Chapter is scheduled for Wednesday, March 10, at 7:15 p.m., again at the Harvard School, 3700 Coldwater Canyon Ave., Studio City. It will feature at least 20 minutes of a RAM session devoted to problems with building computer systems from kits.

For further information about the Valley Chapter, contact either John Scott at 849-7111 or David Resnick at 670-4698.

BACK ISSUES OF INTERFACE

Many new members are requesting that they receive issues of INTERFACE beginning with the first issue. We regret that SCCS does not have the administration to process such requests, or to begin memberships on dates prior to receipt of applications and dues. However, back issues may be obtained by writing separate requests to McPheters, Wolfe & Jones, P.O. Box 1234, Cerritos, Ca. 90701. Back issues of the magazine are $1.75 while they last. Newsletter back issues are no longer available. But take heart . . . within the next three or four months INTERFACE will reprint those newsletters in their entirety.

OTHER PUBLICATIONS

"It was to have been the nuclear age. It became the computer age." This appeared on the cover of THINK, IBM's January/February 1976 publication. The magazine beautifully recaps recent technological history, calling it "Fastest 25 Years."

SEEKING COMPUTER COHORTS

East Detroit resident and computer hobbyist, Dennis Siemiet is looking for buddies who would like to form a computer club (or perhaps an SCCS Chapter). If you're an interested neighbor, write him at 45466 Custer, Utica 48087, or phone (313) 254-9624.

OTHER CLUBS

THE LONG ISLAND COMPUTER ASSOCIATION announced its birth in January. Their newsletter is scheduled for first appearance in March, reports editor, Morris Balamut. Interested New York residents may contact him by writing P.O. Box 864, Jamaica, New York 11431.

NEW YORK CITY MICRO HOBBYIST GROUP now has 26 members, and find themselves ahead of the game in one respect. Several microcomputer manufacturers have expressed willingness to help with design input. All the group needs now is formalized structure, and a place to work on projects . . . preferably a school. Anyone with helpful information may contact Bob Schwartz, 1E, 375 Riverside Dr., New York 10025.

WATCH (Wisconsin Area Tribe of Computer Hobbyists) recently held its first regular meeting. About 30 people attended, and 50 members are expected at the next meeting. For information about future meetings, contact Don Stevens, P.O. Box 159, Sheboygan Falls, Wisc. 53085.

CALIFORNIA COMPUTER SHOW

Norm DeNardi Enterprises is conducting the California Computer Show in Palo Alto on April 22nd. For more information contact JoAnn Griffiths at (415) 941-8440, or write 95 Main St., Los Altos, Ca. 94022.

EDUCATION UPDATE

SCCS EDUCATION PROGRAM

The purpose is to extend to all SCCS members the opportunity to learn more about hardware, software, and other aspects of home computing. SCCS invites your suggestions for classes. Those who wish to teach a class, and those who would like to attend a special class may contact Larry Press, 128 Park Place, Venice, Calif. 90291.

If you wish to take a class that has been offered, contact Larry or the class instructor. Checks for tuition should be made to SCCS. Proceeds from tuition are divided equally between the instructor and SCCS.

BASIC BASIC BASIC

The third SCCS BASIC class will begin on April 19th and will run for approximately 9 sessions. The class, which will be taught by Irven Naiman, will meet on Monday evenings at 7:30 p.m. at the Harvard School, 3700 Coldwater Canyon in North Hollywood (near Ventura Blvd.). Tuition is $25.

POWER SUPPLIES

Fred Schultz will teach an overview course on power supply design. Topics such as supply requirements, transformers, voltage regulators and ripple filtering will be covered. Fred, a consultant who also manufactures power supplies, promises to present many practical tips along with theoretical considerations. This class will meet for 4 sessions beginning the week of April 19th; however, neither the location nor the day of the week have been set. Fred is flexible on time and meeting place, so please indicate your preference for time when you enroll. Your tuition check will not be cashed if the class is scheduled at a time which you indicate you cannot attend. Location will be in West L.A. or the Culver City area. Tuition is $20. The only prerequisite is your familiarity with Ohm's Law and simple DC circuits.

COMING SOON

In a notable effort to spread the joy around, Bruce Scott is organizing three courses to be held in the Long Beach area. Bruce plans a *BASIC* class, a construction techniques class, stressing PC board design and fabrication, and an introduction to digital devices using the E & L breadboards. Bruce Scott would like to begin after Easter and his schedule is open. If you are interested in these classes, or have ideas for others in the Orange County and South LA areas, contact Bruce directly by writing 11711 E. Florence Ave., #21, Santa Fe Springs, Ca. 90670. Better yet, fill out the form below.

Certainly: I want to learn a little more than I know now about some facet of micro-computer or I am willing to share my outstanding knowledge with other SCCS members and guests.

Name: ____________________

Street Address: ____________________

City:__________ Telephone No.__________

I am interested in the following course(s) as:
an instructor ☐ a student ☐

Introduction to Digital Devices __________

Construction Techniques (includes printed circuit design)__________

Power Supply Design and Construction __________

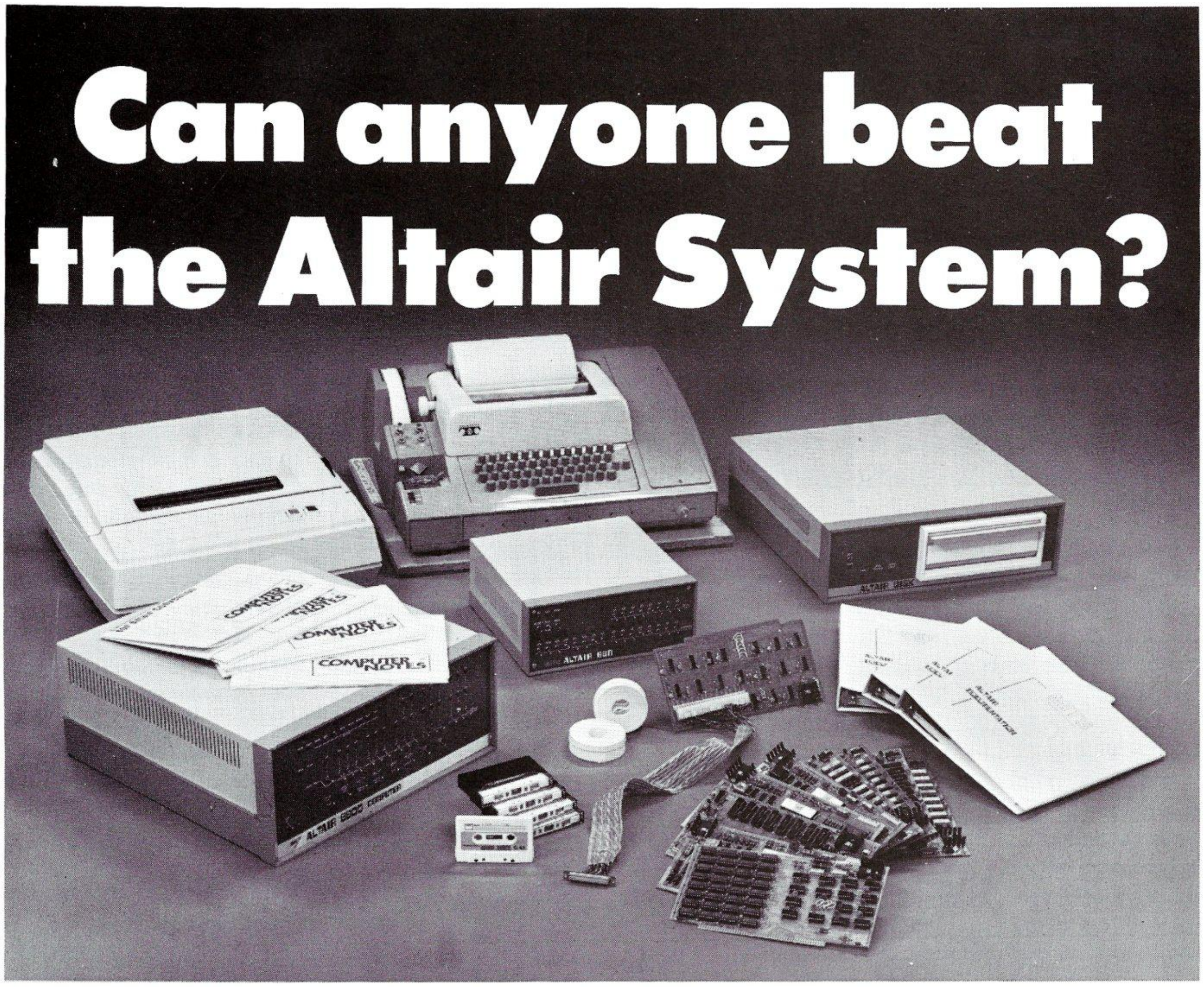
BASIC Programming Language__________

Other____________________

Typical format—Introduction to Digital Devices will meet once a week for five weeks at a location chosen for its convenience to the maximum number of students. Each student will receive approximately ten dollars in parts. The cost of the course will be $35.00 per student.

(Continued on Page 55)

HAPPY EASTER!



We doubt it.

When it comes to microcomputers, Altair from MITS is the leader in the field.

The Altair 8800 is now backed by a complete selection of plug-in compatible boards. Included are a variety of the most advanced memory and interface boards, PROM board, vector interrupt, real time clock, and prototype board.

Altair 8800 peripherals include a revolutionary, low-cost floppy disk system, Teletype,™ line printer, and soon-to-be-announced CRT terminal.

Software for the Altair 8800 includes an assembler, text editor, monitor, debug, BASIC, Extended BASIC, and a Disk Operating System. And this software is **not just icing on the cake**—it has received industry wide acclaim for its efficiency and revolutionary features.

But MITS hasn't stopped with the Altair 8800. There is also the Altair 680—complete with memory and selectable interface—built around the new 6800 microprocessor chip. And soon-to-be-announced are the Altair 8800a and the Altair 8800b.

MITS doesn't stop with just supplying hardware and software, either. Every Altair owner is automatically a member of the Altair Users Group through which he has access to the substantial Altair software library. Every Altair owner is informed of up-to-date developments via a free subscription to **Computer Notes.** Every Altair owner is assured that he is dealing with a company that stands firmly behind its products.

After all, we didn't become the leader by messing around. Shouldn't you send for more information or visit one of our Altair dealers?

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Please send me the following information:
- ☐ Your latest catalog and price list
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GAMES: George Tate, 3544 Dahlia Ave., Los Angeles, CA. 90026 (213) 663-2604
MITS BASIC: Jon Walden, 11557 Sunshine Terrace, Studio City, Ca. 91604 (213) 769-6569

In the first two "Applications Exchange" columns, I asked people to begin letting me know about the applications they were running and were interested in so that I could pass that information on in subsequent columns. I also asked for people who would volunteer to be informal "coordinators" for their favorite applications so that others could contact them for information, programs, etc.

In doing all of this I made one slight miscalculation—at this writing neither of those first two columns has been published yet, and I am trying to write the third based upon feedback from them. This is February, and you won't see this column until April! Oh well, let me know of good material which I can share and also, please consider volunteering to be an application coordinator. In the meantime, I shall return to a subject which was begun last month: what to do until the electrical engineer comes.

Last month, I noted that SCCS has a number of members who are professional computer users, programmers, salesmen, etc., who have little knowledge of hardware. I delineated three areas — electronics, electronic technique, and digital devices and design—in which tutorial information would be helpful. I also suggested that readers write tutorial articles for INTERFACE and requested that they send me references to good tutorial material, which I would pass on or perhaps reprint. No responses are in yet and I'm beginning to understand how those people on other stars and planets feel as they watch us fight the War of 1812 or listen to Jack Benny each week on the radio.

Since I still have nothing to pass on from others, let me tell you hardware beginners of some of the tutorial material which has helped me get off the ground.

In the area of electronics, I can recommend a short book called BASIC DC CIRCUITS by Frank Swan and Warren Palmer. This book is easily understood and may be purchased at any Radio Shack store or ordered through their catalog. It introduces the concepts of an electronic circuit, voltage, current, resistance, and more. In addition it covers analysis of simple DC circuits (Ohm's Law). The book only costs $2, but there is a hooker—you have to do some experiments in order to learn the material and come to really "believe" what you read, and for those experiments you will need a little equipment.

With my $2 book, I got the cheapest Radio Shack voltmeter ($10), a grab bag of assorted resistors ($2), some wire ($1.50) and some alligator clips ($1). (I think I should get a Radio Shack franchise!) I already owned wire strippers and a pair of needlenose pliers or I would have had to get them as well. At any rate, with this book and equipment, you should be able to convince yourself that Ohm's Law is really true.

I would also recommend the Radio Shack book entitled UNDERSTANDING SOLID STATE ELECTRONICS. It costs the same, but doesn't require any experiments. I would say that I understood about 90% of the material the first time through and kept faith that the other 10% would make sense someday. This book tells about transistors, diodes and Integrated Circuits (ICs) as well as repeating some of the material from the first book.

About the time I was reading these, I was given an excellent article which was my first introduction to digital devices and design: *The Best Logic Yet* by Willian Browning in the August, 1975 issue of 73 MAGAZINE. It discusses the functions of some of the TTL gates and gives a few practical tips as to how to keep from destroying them while experimenting. This article is quite easy to understand, but I warn you now that you will feel curious to see if the TTL components really work the way Mr. Browning says they do; and your next round of experimentation will cost a few bucks.

The beginner should also check out a few periodicals. POPULAR ELECTRONICS and RADIO ELECTRONICS are two similar publications which I have easy access to and I like POPULAR ELECTRONICS best. Each issue seems to have a number of relevant articles, but let me warn you that we are no longer speaking of strictly tutorial material so don't expect to understand all that you read. For example, the first, and perhaps last, POPULAR ELECTRONICS article which I read was *How To Design Your Own Power Supplies* by Jim Huffman in the June, 1975 issue. It does an excellent job of communicating the big picture—what a power supply is, what its major subsystems are and what functions they perform—but I got lost in the details.

I feel that it is important for the beginner to build a tolerance for such ambiguity, since we are trying to learn in a "parallel" mode rather than the traditional "serial" mode. For example, a student of electronics

(Continued on Page 55)

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CIRCLE NO. 4 ON INQUIRY CARD

INTRODUCTION TO MICROPROCESSOR TECHNOLOGY

From "Introduction to Microprocessors" reprint courtesy of Motorola Semiconductor, Phoenix, Arizona.

CONCLUSION: Interface has serialized this new and very informative book and has presented it in its entirety over the last several issues.

Chapter II

UTILITY PROGRAMMES AVAILABLE WITH THE M 6800 FAMILY

1. Assembler MPCASM

Any assembler programme has the same function: to translate a programme written in symbolic language into machine language.

However, each assembler uses its own directives, employs a particular format in writing its mnemonic instructions, has special rules associated with the method of addressing, etc. In order to be fully conversant with the characteristics of the Motorola MPCASM assembler, it is necessary to consult the Software Manual of the MPU; in particular, the function of each instruction must be known in detail (72 instructions altogether).

We will now write the programme 5*N in the definitive form it must take before assembly.

```
         NAM MULFIV   ]
         OPT MEMORY   ]
         ORG O        ]  directives
COUNT    FCB O        ]
    N    FCB O        ]
         LDA A #4     ]  load the counter to the value 4.
         STA A COUNT  ]
         LDA A N      ]  load N in ACCA
         TAB          ]  and ACCB.
NEXT     ABA             add the 2 accumulators
         DEC COUNT       decrease the counter by 1 and add the 2 accumulators
                         as long as the count is not zero.
         BNE NEXT
         END          ]  directives
         MON          ]
```

The function of the various directives is explained in the Software Manual; one of them calls for a brief comment:

> OPT MEMORY is an optional directive which allows the subsequent simulation of the execution of the programme.

Note: The Motorola assembler designated MPCASM is a *cross-assembler* available on several time-sharing networks; it is a programme written in an high-level language (FORTRAN IV) thus differing from the assembler language understood by the MPU, which is why it is called a cross-assembler. On the other hand, there are also assemblers called *straight-assemblers* which are programmes written in the same language as that understood by the computer.

2. Simulation

Having the possibility of assembling a programme usable with the MPU, each user connected to a popular time-sharing network (General Electric–Mark III) is also able to stimulate the execution.

In particular, simulation allows a programme to be "traced", i.e., to be executed instruction by instruction. The effect of each instruction can thus be seen and possible programming errors brought to light. In addition, the MPSSIM simulation programme gives the total time required for the execution of a programme; it is thus possible to compare the Motorola system with a competing system.

Motorola also offers assemblers and simulators as stand-alone packages so that the user can assemble and simulate MPU programmes on his in-house computer.

3. Exorciser

Although the MPSSIM programme is extremely useful, it does not allow the simulation of an input-output system or the writing of a programme using interrupts.

Motorola offers a piece of equipment known as the EXORCISER which allows the full testing of a prototype constructed around the MPU, both as regards hardware and as regards software; this machine incorporates all the characteristics of a simulator, in particular the programme tracing facility; the software part of the Exorciser is provided by a firmware programme designated EXBUG, similar in function to the MPSSIM programme but with much greater scope.

EXORciser and EXbug are Motorola trademarks.

SUMMARY

INTERFACE wishes to thank Motorola for the privilege of reprinting this very informative guide to microprocessor technology. We know that it has been helpful to many of our readers.

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CIRCLE NO. 5 ON INQUIRY CARD

by Graham Lee Mahin

THE "QUICK BROWN FOX" random short story generation...

My friend, Randolph, looked at the uncased Altair in the middle of the dining room table and asked, "Besides engineering analysis of a geodesic dome, what else does it do?"

"Why anything you want. It's a powerful tool!" said I, realizing too late that I may have cut off more than the 8800 could chew.

"I bet I know one thing it can't do," said he in all due candor, "write a short story."

In the end, we were both wrong. By that time, we had rolled up our sleeves and tackled the job with a smile. This is the result of our efforts. This program doesn't spit out original screen plays, but it does write stories of a sort. They are random and they are endlessly generated.

Remember the sentences in our early readers "John saw the dog. The dog saw John"? They take on a very different meaning if we replace selected words to get "John shot the dog," or "The dog ate John."

This computer program does the same sort of thing but it changes every word in the sentence except for a few logical connectives that cause it to hang together.

The computer accepts lists of nouns, adjectives, verbs, modifying phrases, and verbs with predicates and then uses random selections from these lists to complete a sentence of the form—

THE (adjective) (noun) (verb) THE (adjective) (noun) AND THEN (verb) THE (adjective) (noun) WHO (modifying phrase) (verb with predicate).

If the lists are rich with science fiction buzz words the program generates a space story. If the lists are related to some other field, the story concerns that field of interest.

Lists of science fiction terms produce . . .

The cowardly Martians demagnetized several uranium fields from the underpaid missile pirates and then made friendly overtures to the oxygen starved intergalactic commuters who methodically re-entered their own atmosphere.

The underpaid Venusians tried to outdo the well trained lunar link launchers and then sent fake gamma readings to the outmatched intergalactic commuters who mainly by hit and miss methods crash landed.

The courageous intergalactic commuters sabotaged the shuttle ships of the cowardly Venusians and then managed to deceive the pulverized space controllers who in spite of warnings from the neutral space controllers disintegrated without a trace.

Stock market buzz words yield . . .

The slow moving floor broker absorbed a deluge of selling from the fast thinking customers broker and then touted a real dog to the trader who was frantically churning over all his remaining accounts while the tape ran half an hour late.

The prosperous analyst was refused on the floor by the fast thinking odd lot broker and then demanded fresh funds from the margin man who was taking his own sweet time to fix the jammed ticker tape as a result of bearish news from Geneva.

The fast thinking customers broker asked for a quote from the shrewd floor broker and then lost his ass selling General Motors short to the translux repairman who was frantically churning over all his remaining accounts despite the bullish atmosphere.

If you don't speak BASIC, a few comments about the program may help. The sequence of steps 15, 20, and 22 is looped ten times. Each time, the computer types a ? that is responded to by the operator. Each operator response is data that the computer stores with an identifying number. After ten inputs from the operator, the computer has stored a list of ten nouns. It moves on to store other lists of words.

The RND instruction at step 70 causes the pseudo-random number generator in the compiler to provide a number from 0 to .999. The complete instruction; Let N = INT (10*RND(1) +1) develops a random integer with a numerical value between 1 and 10. This integer uniquely identifies one of the nouns that the operator entered in steps 15 through 22.

Steps 75 and 80 identify one of the verbs and one of the adjectives, respectively.

Step 100 allows the computer to print the first part of the story by typing THE (one of the adjectives) (one of the nouns) (one of the verbs) THE. The remainder of the program writes the rest of the story with similar random word selections and additional logical connectives.

The complete BASIC program is listed in figure 1. Comments have been inserted to help you understand how the program works.

```
COMMENT: HEADING
LIST
5 CLEAR 3000
6 PRINT “----------EXTENDED QUICK BROWN FOX
                    RANDOM GENERATOR----------”
9 PRINT:PRINT:PRINT
COMMENT: COLLECT TEN NOUNS
10 PRINT “ALL NOUNS—”
15 FOR N=1 TO 10
20 INPUT N$(N)
22 NEXT N
COMMENT: CONNECT TEN VERBS
23 PRINT “VERBS #1 & #2—”
24 FOR V=1 TO 10
25 INPUT V$(V)
26 NEXT V
COMMENT: COLLECT TEN MODIFYING PHRASES
30 PRINT “MODIFYING PHRASE—”
35 FOR M=1 TO 10
40 INPUT M$(M)
42 NEXT M
COMMENT: COLLECT TEN VERBS WITH PREDICATES
43 PRINT “VERB #3 W/PREDICATE—”
44 FOR H=1 TO 10
45 INPUT H$(H)
46 NEXT H
COMMENT: COLLECT TEN ADJECTIVES [GROUP 1]
50 PRINT “ADJECTIVES #1 & #2—”
55 FOR A=1 TO 10
60 INPUT A$(A)
62 NEXT A
COMMENT: COLLECT TEN ADJECTIVES [GROUP 2]
65 PRINT “ADJECTIVE #3—”
66 FOR J=1 TO 10
67 INPUT J$(J)
68 NEXT J
COMMENT: SPACE
69 PRINT
COMMENT: SELECT NOUN, VERB, ADJECTIVE
70 LET N=INT(10*RND(1)+1)
72 LET B=N
75 LET V=INT(10*RND(1)+1)
80 LET A=INT(10*RND(1)+1)
COMMENT: PRINT FIRST PART OF STORY
100 PRINT “THE”;A$(A);” “;N$(N);” “;V$(V);”
     “;“THE”;” ”;
COMMENT: FIND A NEW NOUN
110 LET C=INT(10*RND(1)+1)
112 IF C=N THEN 110
115 IF C< >N THEN LET N=C
COMMENT: FIND A NEW ADJECTIVE
120 LET E=INT(10*RND(1)+1)
122 IF E=A THEN 120
125 IF E< >A THEN A=E
COMMENT: PRINT {adjective} {noun} “AND THEN”
130 PRINT A$(A);” ”;N$(N);” AND ”;
132 PRINT “THEN ”;
COMMENT: FIND A NEW NOUN
140 LET D=INT(10*RND(1)+1)
142 IF D=B THEN 140
143 IF D=C THEN 140
145 LET N=D
COMMENT: FIND A NEW VERB
150 LET F=INT(10*RND(1)+1)
152 IF F=V THEN 150
155 LET V=F
COMMENT: FIND AND PRINT REMAINDER OF
STORY
156 = LET M = INT(10*RND(1)+1)
157 LET H=INT(10*RND(1)+)
158 LET J=INT(10*RND(1)+1)
160 PRINT V$(V);” THE ”; J$(J);” ”;N$(N);” WHO
     ”;M$(M);” ”;H$(H);”.”
COMMENT: SPACE
170 PRINT
COMMENT: START OVER AT INSTRUCTION 70
180 GOTO 70
199 END
OK
```

Figure two is a run used as a test program. The operator responded to each of the computer's ? by entering an alphabetical character and a number. The character was chosen to be appropriate to the part of speech, adjectives were coded A, nouns were coded N, and so forth. The numbers were entered in serial order. All ten numbers were used in each group.

The computer used these lists of coded entries and generated the output shown. These are obviously not stories. They are test sentences that demonstrate the computer behavior.

```
TEST RUN
RUN
-----EXTENDED QUICK BROWN FOX RANDOM
               GENERATOR-----
ALL NOUNS—
? N1
? N2
? N3
? N9
? N0
VERBS #1 & #2—
? V1
? V2
? V3
? V4
? V5
? V0
MODIFYING PHRASE—
? M1
? M2
? M8
? M9
? M0
VERB #3 W/PREDICATE—
? H1
? H2
? H3
? H9
? H0
```

```
ADJECTIVES #1 & #2—
? A1
? A2
? A3
? A8
? A9
? A0
ADJECTIVE #3—
? J1
? J2
? J3
? J4
? J5
? J6
? J7
? J8
? J9
? J0
THE A4 N5 V4 THE A7 N6 AND THEN V3 THE J8 N4
     WHO M0 H9.
THE A5 N7 V5 THE A2 N9 AND THEN V7 THE J4 N6
     WHO M5 H5.
THE A4 N4 V9 THE A8 N1 AND THEN V0 THE J1 N9
     WHO M3 H0.
```

FIGURE TWO

I would like to close with a note of appreciation, first, to my friend, Ed Randolph, for his initiation of the effort, second, to my editor, Bruce Scott, for manipulating the final text. ⍗

BE A WINNER

If you think you are beaten, you are
If you think you dare not, you don't
If you like to win, but think you can't,
It's almost a cinch you won't.

If you think you'll lose, you're lost;
For out in the world we find
Success begins with a fellow's will;
It's all in the state of mind.

If you think you are outclassed, you are;
You've got to think high to rise.
You've got to be sure of yourself
Before you can win a prize.

Life's battles don't always go
To the stronger or faster man;
But sooner or later the man who wins
Is the man who thinks he can.

—Vince Lombardi

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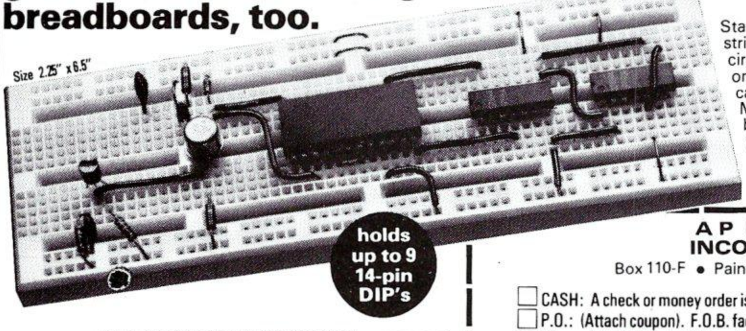

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bubble memory is coming•••

by *T. C. Wirtz*

Ted Wirtz is a Senior Engineer in the Systems Design Division of the Pacific Telephone Company. Ted also writes regular articles for the HP65 Users Notes.

So . . . you finished building your microcomputer, you have a satisfactory I/O device, and now you would like to add a really high capacity, non-destructible read/write memory device. Like maybe a disk memory. Well you probably can't afford most disk memories, so maybe a floppy disk, or maybe a . . . hold on! Something new is on the horizon! It has high capacity in small volume, random access, no data loss when power is off, consumes very little power when in use, costs less than disk, and has no moving parts. Quick, I want one! What is it?

Easy there, stop drooling, and while you wipe your chin, I'll tell you. It's called a bubble memory. And is it compact? How does 100 million bits per cubic inch sound? Fairy tale? No, reality. In fact, laboratory models have been built that even exceed that capacity. A simpler version will go into production this year, a single wafer device, with a 250,000 bit capacity. The total package, less power supply, is the size of a deck of playing cards.

Okay, now I'm really sold. But what is it? How does it work? Best place to start is at the beginning.

HISTORY

It all started back in 1967 when it was observed that a unique phenomenon occurred in magnetic crystals of a certain class called orthoferrites. These crystals could be magnetized only along one axis of the crystalline lattice. This property made them "uniaxial." However, the magnetism could point in either direction along the axis. Further, it was observed that if polarized light was shined through a thin section of the material along the magnetic axis and then viewed through another polarizing filter, the magnetized areas became visible when viewed through a microscope. Although the net external magnetization appeared to be zero, when viewed microscopically, the crystalline magnetization could be seen alternating from north to south and back again in a twisting serpentine pattern. These individual areas were called "magnetic domains." (Figure 1)

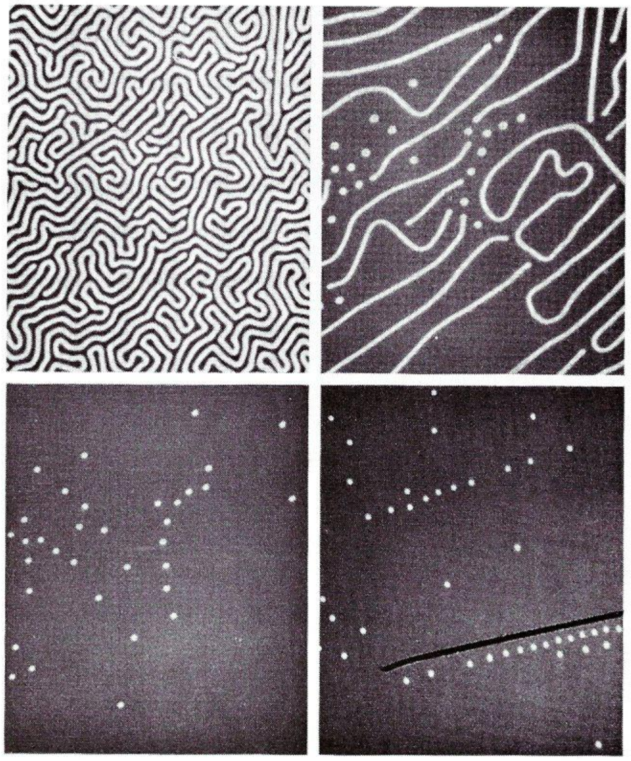


FIGURE 1 - 4

EMERGENCE OF MAGNETIC BUBBLES in a thin wafer of magnetic garnet is demonstrated in this sequence of photomicrographs taken at the Bell Telephone Laboratories. The magnetic domains in the specimen rotate polarized light in different directins depending on whether the internal magnets in the crystal point up or down. By adjustment of a polarizing filter domains with the same orientation can be made to look either bright or dark. When no external magnetic field is present (top left), *the domains form serpentine patterns, with domains of opposite magnetization occupying equal areas. (The apparent departure from equality here is an artifact of the exposure.) When an external magnetic field is applied pependicularly to the specimen* (top right), *the domains that are magnetized in the opposite direction shrink and in a few cases contract into bubbles. Although these circular domains are called bubbles, they are actually stubby cylinders viewed from the end. A further increase in the xternal bias field* (bottom left) *converts all the remaining "island" domains into bubbles. With a "soft" magnetic wire whose magnetization is polarized by the external field one can move the bubbles around freely* (bottom right). *Because the bubbles repel one another they tend to maintain a certain minimum separation. Nevertheless, they can be packed with a density of more than a million per square inch.*

It was then discovered if an external magnetic field was applied parallel to the magnetic preferred axis, the oppositely magnetized domains would shrink until most of them disappeared. A few of them however would each shrink down to a stable cylindrical volume, and remain as such. The "bubble" was born. (See Figures 2, 3, 4.) These bubbles could then be moved by locally disturbing the bias field. If the bias was increased above a certain critical strength, the bubbles would collapse into nonexistence.

But why were they stable below critical bias? It was determined that the bubble (remember, it's actually a stubby cylinder) was surrounded by a transition zone called the "domain wall." Opposite sides of the domain wall tended to oppose each other, thereby resisting collapse of the bubble. (See Figure 5.)

All of this was the beginning of the makings of a memory device. If the bubbles could be made to move along a predetermined path in a predictable manner, then presence of a bubble could represent a "1," and absence a "0." A technique for controlled generation of bubbles would be needed to "write" and another to collapse them as needed ("erase"). To this add a bubble sensor and you have a read/write memory.

But would it be practical? Would it be competitive with other memory devices? Or could it even be superior? Researchers set out to answer these questions. The answers were very favorable if certain goals could be met.

DENSITY

One goal which had to be met was to achieve high density. A goal of one million bubbles per square inch was set. Since all bubbles are of like magnetization, they tend to repel each other. This interaction can be minimized as long as the bubbles are kept three diameters away from each other. This meant if the density goal was to be met, the bubbles would have to be .0003 inch in diameter or smaller. Orthoferrites had bubbles much too large. A new family of materials would have to be found. The answer was found in rare earth garnets. These garnets with appropriate "doping" had bubbles of the required size, or even smaller.

MOBILITY

The next goal was mobility of bubbles in the slice, using a minimum of power to move the bubble. A goal was set of moving a bubble at a rate of at least one million steps per second. This rate would be needed to "read" bubbles without undue delay. Of course, implicit in this goal was the need to come up with a simple way to move bubbles. Many different approaches were tried.

BUBBLE MOVERS

One method used successfully was called "conductor access." The technique consists of placing microscopic conductor loops on the chip and then sequentially energizing the loops (see Figure 6). The main drawback to this approach was the multiplicity of electrical connections to the loops.

Another approach was a technique called "field access." It was observed that if the bias field was decreased in a local area, nearby bubbles would move to this area. Also, if patterns of "soft" (readily magnetized) magnetic material was deposited on the surface of the crystal, the bubbles could be made to follow the pattern, by varying the bias field in different ways. Permalloy seemed to be an ideal "soft" material.

Two particular patterns held particular promise. Both worked well when used with a rotating magnetic field perpendicular to the bias field. These patterns were called the "T and bar" and a modification called the "Y and bar." (See Figures 7 and 8.)

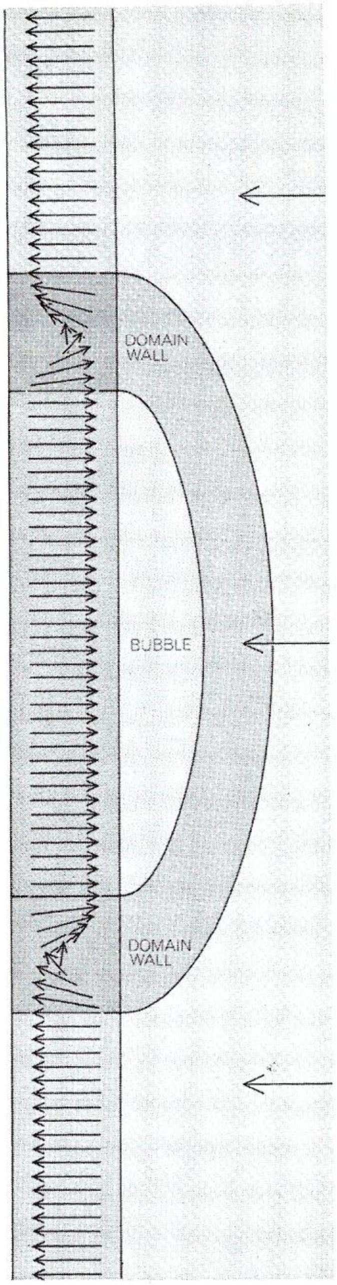


FIGURE 5

DOMAIN WALL is a transition zone through which the magnetization reverses direction. The force exerted by the domain wall combines with the force of the external field (arrows at right) *in effort to reduce the diameter of the bubble domain.*

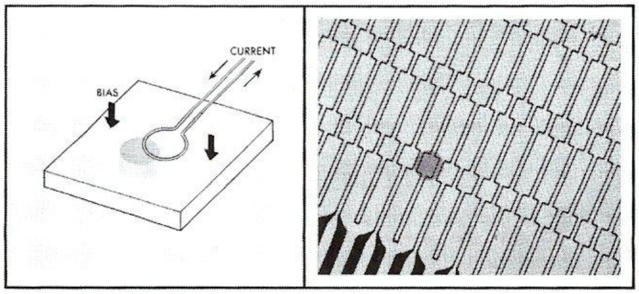


FIGURE 6

A bubble domain responds to deviations from a uniform bias field. Current applied to the conductor loop locally decreases the magnetic field, and the bubble reacts by moving beneath the loop. In an actual conductor circuit, 0.004-inch bubbles are moved faster than 10 million steps per second.

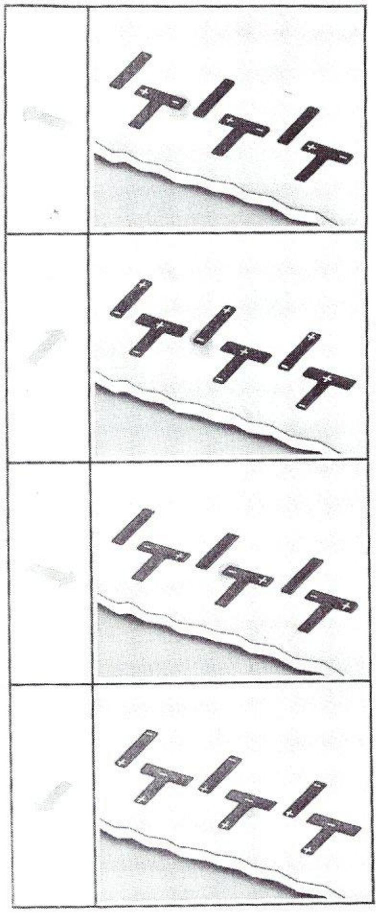


FIGURE 7

A pattern of T's and bars, which results from selectively etching a thin film of permalloy, uses energy from a rotating magnetic field applied in the same plane as the thin film to move the bubbles. As the field rotates clockwise, as indicated by the arrows at the left side of the drawing, the magnetic poles move the bubbles from left to right.

BUBBLE LOGIC

Still further variations permitted construction of divide-by-two, and, or, nand, and even full adder logic circuits. All these took advantage of the fact that bubbles repel each other. All the various logic circuits were categorized as "interactors." (See Figure 9.) By using a variation of the idler as shown, it was even possible to cross streams of bubbles at right angles and not disturb the pattern of either stream. Obviously, if needed, both memory and logic could be designed into the same chip, although the logic would be a bit slow by today's standards.

BUBBLE GENERATORS

In order to "write" binary information into a memory or logic circuit, bubble generators were devised. For conductor access devices, the bubble-splitter was designed. For field access devices, the rotary generator was fabricated. (See Figure 10.) The bubble-splitter could generate bubbles on command, but the field access bubble-generator created a new bubble with every rotation of the access field. There would need to be some way to "turn off the bubble machine" (thank you, Lawrence Welk). We'll discuss this in more detail later.

BUBBLE-"EATERS"

Now what do you do if you want to eliminate a bubble? It's obvious. Feed it to a bubble-eater! Again, bubble-eaters (or anihilators, if you like technical names) were constructed for both conductor access and field access devices. The conductor access device worked somewhat like the bubble splitter, using a pulsed conductor loop. However unlike the splitter, the loop surrounded the bubble so it could not escape. The locally intensified magnetic pulse which resulted when the loop was pulsed electrically, collapsed the bubble.

The field access bubble-eater was also a lot like its companion generator, but by using a modified permalloy pattern, the unwanted bubble was forced to merge into the unstable magnetic structure, causing it to join its ancestors.

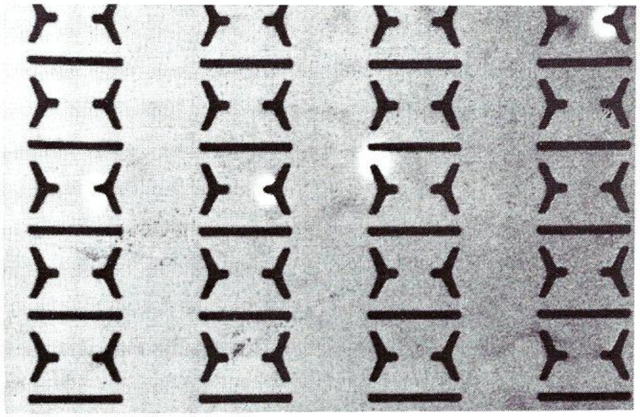


FIGURE 8

Magnified magnetic bubbles (the light spots) move through a circuit pattern on a thin epitaxial film of uniaxial garnet. The Y- and bar-shaped elements are part of an experimental shift register made at Bell Labs. The somewhat elongated bubble is in transition from one pole to the next. The bubbles are three ten-thousandths of an inch in diameter and each represents an information bit.

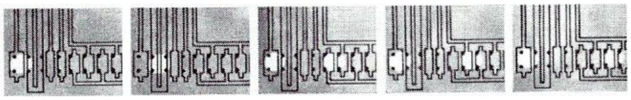
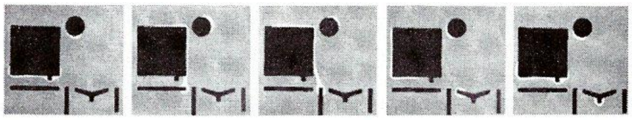


FIGURE 9

DIVIDE-BY-TWO CIRCUIT employs an idler that traps every other bubble. Here two bubbles approach the idler from the left. The first bubble is diverted into the idler (loacted between the second and third T from the bottom). Its presence in the idler forces the second bubble to stay in the horizontal track. The passage of the second bubble in turn forces the first bubble out of the idler.



BUBBLE-SPLITTER consists of of a special loop with an internal hairpin circuit that can be separately energized when a bubble is centered above it (second frame from the left). *When current flows through the hairpin circuit, the bubble is split in two even faster than it can be photographed (a few millionths of a second). Subsequently one bubble of the new pair moves off to the right.*

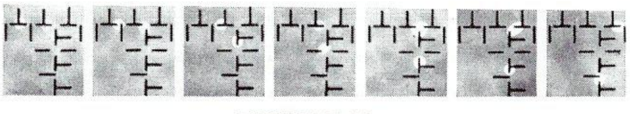


FIGURE 10

BUBBLE-GENERATOR is a field-access device that can create a new bubble every time an in-plane field makes one rotation. The domain appearing as a white crescent projecting from the black disk shows the field direction. The bubble originates as a filamentary strip that becomes circularized after it has split away from generator. Thereafter it is carried to right by modified Y-bar pattern.

BUBBLE SENSORS

All of the above was to no avail if there was no way to electronically sense the presence or absence of a bubble at a specific location. One approach used success-

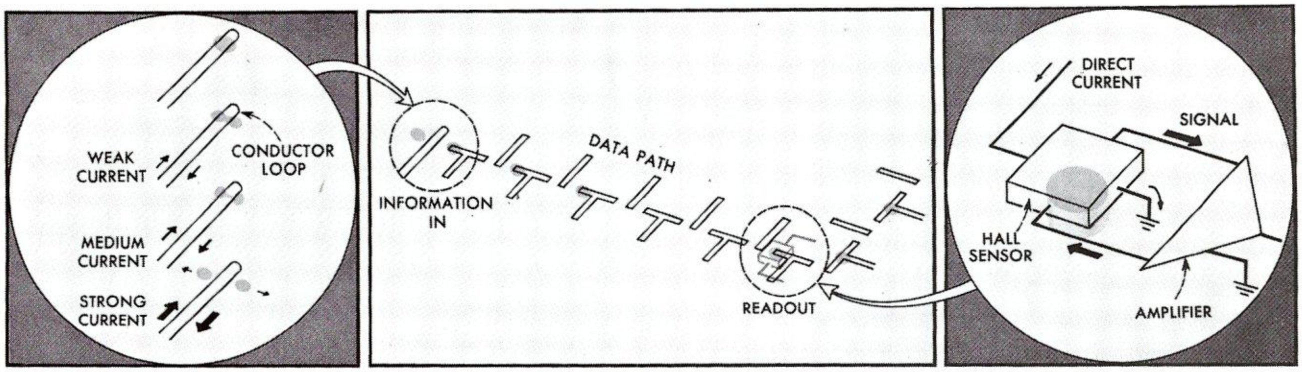


FIGURE 11

In this rather idealized bubble shift register, bubbles move from left to right. Data are inserted by selectively splitting a source bubble (left drawing). The bubble is formed to indicate a binary "1," and is not formed to indicate a "0." The resulting coded bubble stream is moved and temporarily stored by the T-bar register (center drawing). Silicon circuits along the T-bar channel (right) read the stream of bubble signals. (The circuits sense the presence of a bubble by the influence of the magnetic field on electric current—known to physicists as the Hall effect.) During a calculation, one bubble can return to a sensor often.

fully was to deposit a Hall device on top of a specific site on the completed bubble chip. (Very simply, a Hall device is a square or rectangular chip of silicon.) From an external power source, a small electric current is made to flow through the length of the chip. When no external magnetic fields are present, current flows uniformly through the chip. When influenced by a magnetic field, the current tends to flow more along one side of the chip, and less along the other. This difference causes a voltage differential of one side vs. the other. This difference is then amplified by a differential amplifier whose two inputs are connected to the sides of the silicon chip. (See Figure 11.)

Another obvious approach was to sense bubbles optically, using L.E.D.'s polarizing filters and a photocell.

Both approaches, though workable, complicate manufacture. The sensing method which seems to have won out due to simplicity uses the principle of magneto resistance. Certain materials, including permalloy, vary in their electrical resistance in proportion to an external magnetic field. By depositing a thin film of permalloy across the bubble path at the detection site, every time a bubble passes under the film, the additional change can be sensed and amplified by an off-the-chip amplifier. This eliminates silicon depositing on the bubble chip.

MEMORY ORGANIZATION

There are many ways in which a memory can be organized. The simplest is merely a long closed loop shift register, as shown in Figure 12. The path zig-zags up and down in an accordion-like pattern, finally crossing over the top, past the generator, sensor, and anihilator, then rejoins the zig-zag.

This approach is fine for a small memory. But if you use this construct for a one million bubble memory, at a transfer rate of one million bubbles per second, you would have an average access time of one half second to read a specific word. Clearly, a really large mass memory must be organized differently.

The solution is the "major-minor loop" design (Figure 13). This arrangement makes use of field access to move bubbles in the loops, and conductor access to transfer bubbles between loops. Note that this configuration results in a combination serial-parallel organization of memory. A word is written serially onto the major loop. When the bubbles have been shifted to the correct position, the transfer loops are pulsed transferring every other bubble (or gap) onto a different minor loop. The major loop is shifted by one more position, and the transfer process is repeated. The major loop is now empty, and two bits of the original word are now located in each of the minor loops. (Since the bubble generator can't be turned off, unused bubbles are anihilated.)

Reading of the bubbles involves transfer of bubbles from the minor loops back to the major loop, which shifts them past a sensor. Once sensed, they are shifted back to the minor loops and retransferred. If the major loop contains the same number of steps as a minor loop, or has an exact multiple, the gaps in the minor loop will be in proper alignment to receive the bubbles in their original positions.

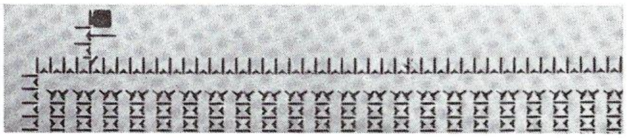


FIGURE 12

TEN-THOUSAND-STEP REGISTER is contained on a chip a tenth of an inch on a side. Only about 7 percent of the complete register appears in this micrograph. The bubbles are guided by a Permalloy pattern of Y's and bars. The bubbles are barely visible as light-toned dots resting in the gaps between the two kinds of structure. The bubbles are injected in to the register by a bubble generator (square black shape at the upper left in the micrograph). *A sensing element, which does not appear in the micrograph, can read on command binary data that has been encoded in the flowing stream of bubbles.*

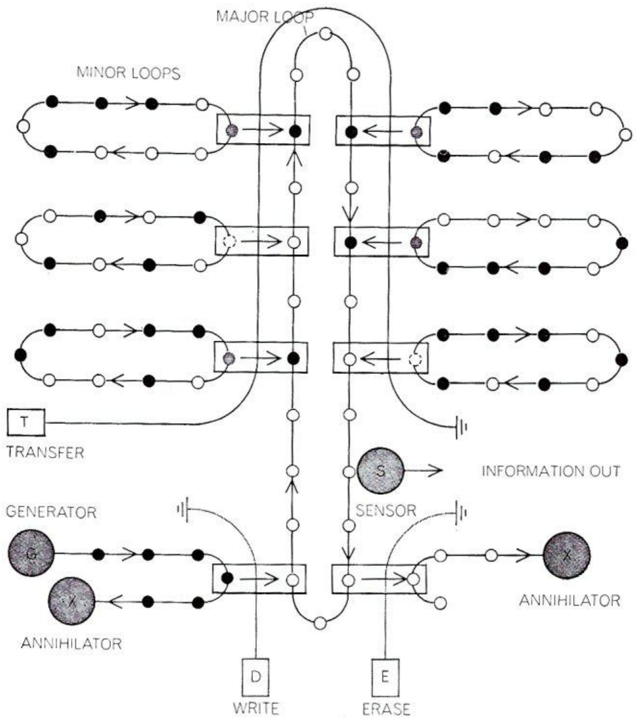


FIGURE 13

BUBBLE MASS-MEMORY can be organized so that a number of minor loops hold data and transfer them on command into a major loop for readout. Here data (light color) have been transferred from six minor loops into a previously empty major loop. The resulting gaps in the minor-loop data streams can be replaced by either the old data or new data. New data are inserted into the memory by transferring selected bubbles form the bubble reservoir loop (G-X) in response to "write" commands (D). Data are erased from the memory by operating (E) and transferring bubbles from the major loop into the annihilator (X) at lower right. Major-minor loop blocks with a capacity of 20,000 bubbles each, interconnected into a rectangular array, provide random access to streams of data in a 15-million-bit memory. T's and E's are interconnected along horizontals, D's and S's along verticals.

DYNAMIC ADDRESS REALLOCATION

Now let us assume that a word has been written into a given position in the minor loops. We now want to reassign this word to a different position or address within the minor loops. To do this, we want to extract the word, hold it in some sort of buffer, rotate the minor loops to the desired position, and then place the word back on the loops. Furthermore, let's even say that when the word is extracted, we want to close up the gaps where it was located and open up gaps at the desired location to accept the word as it is restored.

This capability has been implemented within bubble memory. Assume the loops shown in Figure 14 are portions of the minor loops. Figure 15 illustrates the principle of operation. When the bubbles shift in a clockwise direction, the bubbles move through the buffer, but when the rotation of the access field is reversed, the buffer is isolated, and the bubble (or gap) remains trapped in the buffer. The remaining bubbles take a "short cut" around the buffer, closing the gap, and move counter clockwise under control of the access field. When the field rotation is reversed again, the bubbles again step through the buffer. The bubbles trapped earlier now become part of the stream again. The "word" has been placed in a new location or address. Note that the major loop was not involved in this readdressing.

Figure 15 shows the magnetic pattern used to implement the reallocation logic. It makes use of a special variation of the magnetic idler described earlier. A bubble entering the idler from the left side can exit on the right as illustrated by the arrows. However, if the access field rotates in the opposite direction, the bubble remains trapped, traveling a tight clockwise path within the idler. Meanwhile, due to the asymmetry of the central "T" (upside down), the other bubbles bypass the idler and move from right to left, closing the gap. When the access field rotation reverses again, the bubble stream flows through the idler, and the trapped bubble exits, joining the stream in a new position.

SOLVING MASS PRODUCTION PROBLEMS

It's one thing to build a laboratory model. To mass produce it is something else. Everything described so far has been built in experimental models, or is based on projection of experimental results.

RARE EARTH GARNETS

Earlier in this article, I mentioned the need for small bubbles. Rare earth garnets seemed to answer the need, but could these garnets be mass produced? These garnets might be such exotic compounds as yttrium samarium iron gallium garnet ($Y_{2.62}\ Sm_{0.38}\ Fe_{3.8}\ Ga_{1.2}\ O_{12}$) or erbium europium iron gallium garnet ($Er_2\ Eu\ Fe_{4.3}\ Ga_{0.7}\ O_{12}$) or gadolinium erbium iron gallium garnet ($Gd\ Er_2\ Fe_{4.3}\ Ga_{0.7}\ O_{12}$). You don't buy garnets like these at your local gem shop.

To complicate matters further, it was determined that optimum bubble characteristics were obtained when bubble depth and bubble diameter were equal. (Remember that a bubble is actually cylindrical in shape.) Cutting and polishing a crystal .0003 inches thick was obviously out of the question.

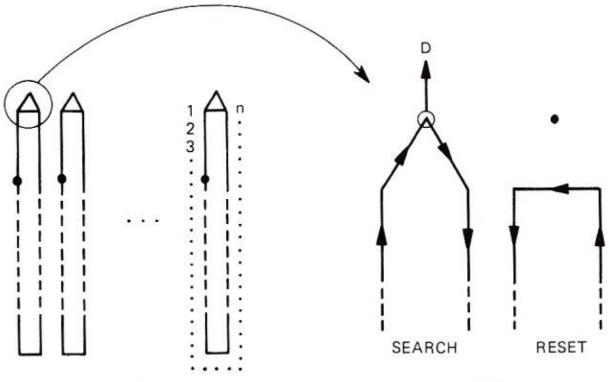


FIGURE 14

Assembly of shift register loops for dynamic address reallocation.

The answer clearly was to grow a thin film of the required material on a thicker substrate. But what kind of substrate? The answer ultimately was to use a simpler garnet compound that was nonmagnetic, but which had similar crystalline properties. It could be grown using bulk crystal techniques similar to those already in use for silicon, germanium, ruby and other synthetic crystals. The crystal was then oriented, sliced into wafers, and polished.

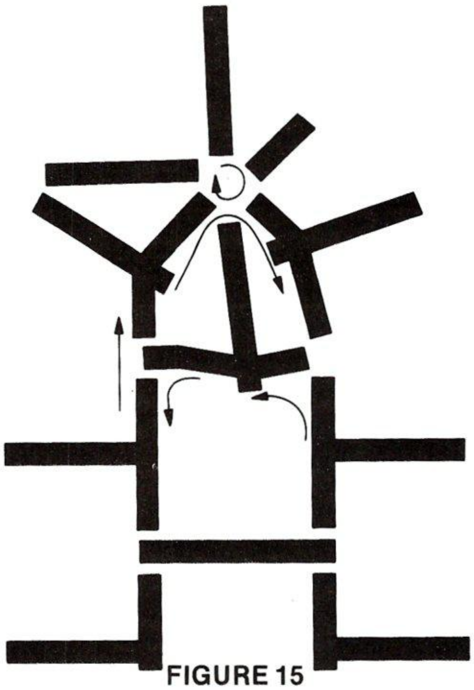


FIGURE 15

Magnetic circuit used to realize the function of Figure 14b.

The wafer substrate was then "dipped" in a platinum crucible containing a super saturated melt of rare earth garnet. The rare earth garnet would then grow on the substrate, in the same crystalline orientation as the substrate. A film of the required thickness could be grown in about fifteen minutes. This process is called "Liquid Phase Epitaxy" (LPE). LPE is also used widely in the semiconductor industry.

Okay, so now we have a method to produce large quantities of rare earth garnet. What next?

HARD BUBBLES

As researchers continued experimentation with bubble devices, it was observed that occasionally a bubble would be found that exhibited distinctly different behavior. These bubbles were called "hard bubbles" (HB) as opposed to "normal bubbles" (NB). Hard bubbles strongly resisted collapse, making them difficult to anihilate. In addition, they exhibited low mobility, compared to NB's, and refused to move parallel to the exciting field. In fact some bubbles were observed to move away at an 80° angle from what would be expected. Hard bubbles would not follow a permalloy pattern except at extremely low propagation rates.

After much study and mathematical analysis, it was concluded that the maverick behavior was due to abnormalities in the domain wall. Instead of the smooth magnetic reversal exhibited by an NB domain wall, an HB domain wall was broken up into alternating parallel and reversing segments called Bloch and Néel segments. It was further determined that the "hardness" of the bubble was directly related to the number of segments. The more segments the harder the bubble.

Further analysis indicated that if an additional domain wall could be formed on either the top or bottom of the bubble it would essentially provide magnetic "short circuit" for the twisted segments, allowing them to unwind, resulting in a normal bubble.

Much experimentation followed. Multilayer garnet films were an answer, but were quite difficult to make. Ultimately, ion implantation of hydrogen into the surface of the film solved the problem. Hard bubbles cannot exist in a properly implanted film. And so another obstacle was overcome.

All this pretty well brings us up to date. As I indicated earlier, at least one manufacturer (and probably more) is today setting up a manufacturing line to build bubble memories.

APPLICATION

Initially produced memories will find application wherever large capacity memory is needed, and where space and power are at a premium. My own personal prediction is that bubble memory will find widespread application in the sophisticated programmable calculator field, both desktop and handheld versions. Today, a million bit bubble memory can be shifted one million steps per second while using only 40 milliwatts of power. This could most definitely be battery powered. The best part of all, of course, is that the bubbles remain intact when power is turned off, so all programs are available when power is turned back on. (The magnetic bias field is provided by permanent magnets external to the memory. Power is only needed to provide the rotating access field.)

Future applications will definitely replace disk devices. Continuing research will permit multi-wafer packages with 128 or more wafers sandwiched between the permanent magnet bias field units. Multilayering coupled with dynamic address reallocation will allow random access times of less than ten microseconds in a major/minor loop type memory, (compared to about fifteen milliseconds for present bubble devices). A package the size of an encyclopedia volume will contain about 15 million bits. Cost of such a package will be much less than equivalent solid state memory.

Wait a minute! Multilayer memory, dynamic address reallocation, major/minor loops—this all sounds complicated!

It is, but no more than disk. Think about how a diskpak is organized. When data at a specific address is needed, what happens? First the disk controller must decide which of several platters contain the data. Then it determines whether it is on the top or bottom surface. Then which track, and finally, which sector. In addition, a head positioning servo and its electronics are required to position the read head. Remember, a bubble memory has no moving parts, no positive pressure chambers, no absolute filters, no possibility of expensive head crashes. And it's 10 times faster.

So there you have it. The computer industry stands on the very brink of another technological breakthrough that will still further reduce costs and at the same time, increase capability. No, you can't buy a bubble memory at your local computer store. At least not today. But next year? Just maybe.

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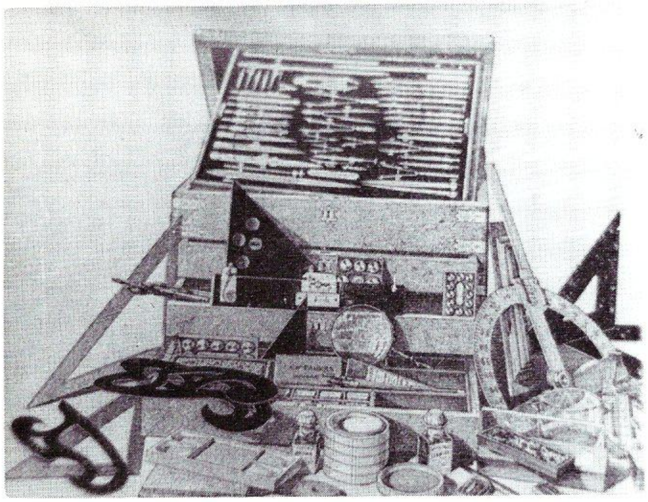


CALCULATIN' ENGINES

by William E. Peterson

The swollen river of mathematics, fat with symbols and techniques, laps ideas at our feet. Ideas swept to us from the dimmest reaches of time. The source of the river is back there, somewhere. Let us together trod the footpaths of the past, down these twisting winding trails to where all computation begins. To the wellhead, without which the river would be but a trickle, we seek the source of mathematics, *numbers*. It begins with counting. What a simple thing, to count. How each of us learned has probably disappeared from individual memory. Yet ancient peoples had to keep track of agricultural produce, sheep, cattle. A visual number sense is one of man's inheritances. Generally, man can only sense visually up to about four. Many animals and birds can do the same. Look at a group of people on a street corner sometime, and guess at the number of people there, then count them. You will find that you can accurately guess only up to about 4. Your "number sense" has reached its limits. In order to do simple agricultural chores, people had to learn to count. This is the basis of mathematics.

Ancient people made use of their fingers (and toes sometimes) in calculation. This is because there (at the ends of their arms) they discovered a "one to one correspondence" machine. If you want to "count" how many sheep you have, you can match a finger against each sheep. If you have say 7 sheep you have matched 7 fingers and you know by looking at your hands that this is less than 10. Now this handy machine doesn't care whether you are counting sheep, cows or soldiers, the "one to one correspondence" scheme still works.

Therefore, your basic technique is to use one to one correspondence in everything! Interestingly enough, primitive people who haven't yet learned to use correspondence don't have much of a number system. Stone age tribes that have been discovered and studied in modern times will have a counting scheme such as "one, two, many." "Many" sufficing for all large numbers. While we may sneer at such primitives, we use much the same thinking. Instead of, say, expressing the *number* of grains of sand on a beach, we will use the word "infinity." Now a number like 10^{100} is a very far cry from infinity. "Infinity" is our word for "big number," or "many." In antiquity, the type of number scheme you develop is in many ways a function of your environment. People who are somewhat advanced use both hands and consequently have a base 10 number system. People that are under constant danger of attack must carry a weapon. This makes counting on both hands a problem. Such people tend to count on one hand. The base of their number system tends to be five. The Roman Numeral system at least starts out as this type, I, II, III, IV, V. Maybe V stood for the thumb.

People who must neither stand ready for flight nor carry a weapon can therefore afford the luxury of sitting down and using their toes. These tend toward a base 20 number system. Babylonian counting tends to emphasize this number 20, and Babylon was mainly agricultural. It is from Babylon we get the use of 60 (or 3 x 20) seconds in a minute and 360 (or 18 x 20) degrees in a circle.

The French still count 21 as 20 + 1 (vingt-et-un) and four-score in English represents (4 x 20) where score is the old word for a base 20 system. Four score in French is expressed as (4 x 20) quatre-vingt, and needless to say at the football game we "keep score" (or count the points won).

Now all of these ancient counting schemes use correspondence. Because of this no operations are done with numerals themselves. Correspondence is used for the computation and the answer is written down. Hence, we have in ancient writing various schemes to write down the answer such as Roman I, II, III; Egyptian III (3); and Babylonian triangular shapes pressed into clay tablets, (uniform).

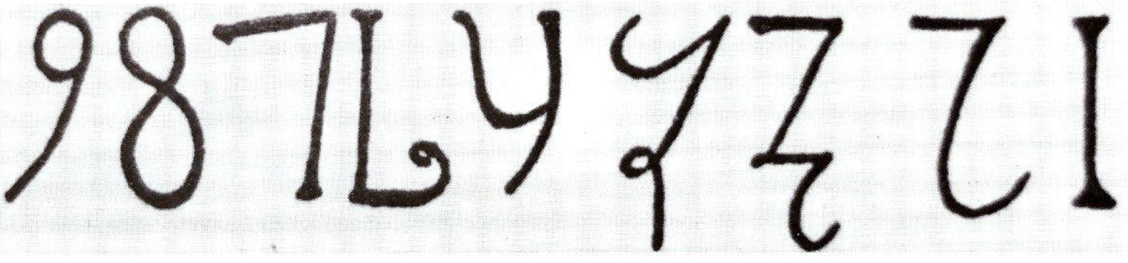
To count large numbers beyond the capability of fingers and toes requires sneaky techniques, but still one to one correspondence based. For example, a large army would be counted by having each soldier pick up a pebble. Then the soldiers would file by a basket and toss their pebble into the basket. The "calculator" would wait until say 10 pebbles were in the basket and he would remove them, tossing one pebble into the 10's basket. By including a 100's and 1000's basket the size of an army was computed. The "calculator" then informed the king (who probably couldn't count) how large his army was. Incidentally, calculus is the Latin word for pebble, hence our "calculator" above used pebbles.

To count cattle or sheep a narrow spot was provided through a fence and the "calculator" would drop a pebble into the basket as each animal passed by. By juggling pebbles around to the other baskets the count or "tally" of the animals was taken.

If you have taken the tally of your sheep and you wish to sell three you have just run into a subtraction problem. However, by removing one sheep from the pen and one pebble from the basket, you can still keep track of how many sheep you have left. But you can't tell how much money you will get for *all* three sheep unless you know how to multiply. Hence you sell each of the sheep one at a time. Try to get the most for each one, and receive the money for each one individually, *not*in a lump sum. When you have *all*the money in your hands *then* you count it to see how much you have. Now you can see why ancient business transactions took perhaps all day to sell 12 sheep. It's because of the arithmetic! Don't think that this scheme has disappeared; many of the world's poorer farmers still operate like this. In Mexico, Spain and other countries, bartering for each item individually is still "standard practice" in business, in fact it's custom. So the early computing devices were fingers, toes and pebbles (we won't count baskets). Pebbles tend to get lost and "goof" the tally. Hence, by providing beads on a frame (counting board) of some kind, counting, addition, and subtraction are facilitated. For example, the soroban and abacus are improved forms of a counting board containing beads in a frame arranged to count in a base 5/base 10 scheme. China is believed to have adopted the abacus from the Romans, the greatest proponents of base 5. When counting verbally, Chinese use a base 10 system, when computing (using the abacus) the words for the same number are different. The Chinese, therefore use a different word for, say, 8 when expressing it, or computing with it. Gets tricky doesn't it?

Because the written form of numbers were only used for answer recording multiplication and division, operations are cumbersome if not impossible. Try to divide XCVII by LIX without converting to arabic numerals and sticking with Roman numerals sometime. This is where the genius of the Greeks shine. Through geometry, multiplication and division become possible. The answer is obtained by measuring lengths of lines and again writing the answer down. Euclid's proposition about ratios (notice division) of triangle parts one to another allow complex operations to be performed geometrically. Not only that, but new strange things not previously thought of become possible. Equations, square roots, cube roots can all be geometrically expressed and solved. This is why Euclid's books were considered the basics of mathematical learning world wide until 1850 A.D.

Because geometry provided a way out of cumbersome problems, operating with numerals made no advancement until about 1000 A.D. The key to numeral operation comes with the use of zero (0). The use of the zero implies that numbers have value of *position.* The number 15 is represented by the 1 having a value of 10 due to *position* and the 5 being *only* five units due to *position.* With this position method of writing, how do you record the answer reached on an abacus if a column in the center has *no* beads? You must invent a symbol for nothing! The Greeks never stumbled into this because they solved difficult problems geometrically, and a line length inherently avoids that problem. With position recording, a numeral can have many different values depending on *where it is placed* in a large number. But a nothing, a void is a very abstract concept if you aren't using a positional system. It is the Hindu that we credit the origin of this concept. Their psychology was such that "sunya", their word for *blank,* was not mentally connected to the concept of *nothing.* The use of zero reached the western culture through the Arabs. At about 1000 A.D. the Arabs adopted Hindu recording techniques and the Arabic translation of "sunya" became "sifr." The adoption of the (so-called) Arabic system by the Western European came through Italy in about 1300 A.D. Italy, using Latin, translated "sifr" to a Latinized form of "zephirum" and eventually this becomes "zero." However, an offshoot of "sifr" appears when Jordanus Nemerarius translated the Arabic and introduced the Arabic system to Germany. His translation became "cifra" and after translation to English becomes "cipher."



Oldest example of modern numerals. Note absence of zero (Circa 976). Photo by Chuck Frasher.

Because of the mystic meaning behind the word and concept of a void with a name "cifra," the word "cifra" was a password to secret societies of dubious quality in Europe. To crack into these secret societies of course is to "decipher" them, a new word for the English language. Now common folk noticed this use of that mystic symbol, and calculators were always muttering "cifra" or "cipher," and so to *do arithmetic* became "ciphering." For those of you mystically inclined, stick to mathematics, a wondrous (and maybe black) art! As a matter of fact this "ciphering" was so advanced and new that a wealthy German merchant of the 1400's wanted the *best* for his son's education. He asked a professor of some prominence at the university "where is the *best* in calculating knowledge to be found?" and was told that Germany was fine for adding and subtracting, but the arts of multiplying and dividing had reached their pinnacle in Italy! That was the advanced course.

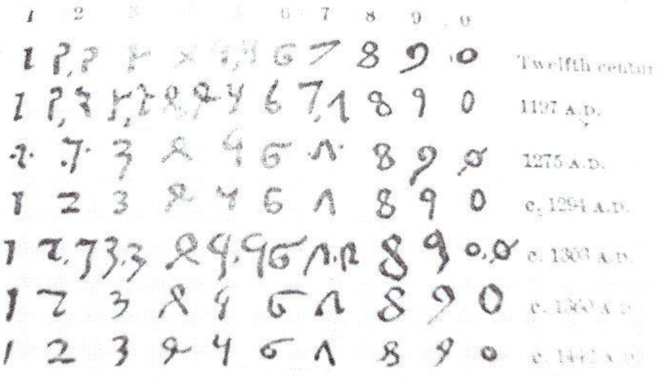
The symbols used for numerals have undergone many variations. It is only with the advent of printing, and the need to reduce the number of different pieces of type, that the number symbols standardized to today's set. Yet even today the symbols are somewhat different. In the USA we write 7, yet in many parts of Europe a small line is added through the vertical leg of the symbol. The major changes after printing came in the numeral symbols of 4 and 5.

But from whence came our symbols for operation, such as +, -, = ? One thought on the + and - signs is that they originated in Holland, in the fifteenth century. When shipping baled goods, and Holland at that time was a sea power of considerable note, the excess or deficiency of required weight was written on the goods: 6c. + 4 lbs. (an excess of 4 lbs. overweight). In 1540 they came to denote *operations*.

In Recorde's Whetstone of Wit published 1557 he makes the earliest mention of the = sign saying "no 2 thyngs can be moare equalle" and the = sign was used in algebra at that time.

And so we have meandered through a bit of early calculation history and the whys and wherefores. Let's conclude with an excellent excerpt from the earliest book on arithmetic printed in England. This text "The Grounde of Artes," by M. Robert Recorde, Doctor of Physik, first published in 1540. Quoting from a 1573 edition, the teacher tells his student: *"Master*—If numbering be so common that no man can doe anything alone, and much less talke or bargain with other, but still have to doe with numbre; this proveth not numbre to be contemptible and vile, but rather right excellent and of high reputation, sithe it is the grounde of all mens affaires, so that without it no tale can be told, no bargaining without it can dully be ended, or no business that man hath, justly completed . . . Wherefore in all great workes are Clerkes so much desired? Wherefore are Auditors so richly feed? What causeth Geometricians so highly to be enhaunced? Because that by numbre suche things they find, which else would farre excell mans minde."

"Scholar—Verily, sir, if it be so that these men by numbring their cunning doe attaine, at whose great workes most men doe wonder, then I see well that I was much deceived, and numbring is a more cunning thing than I take it to be."



Evolution of written numerals. Photo by Chuck Frasher.

COVER STORY

Rockwell International, Microelectronic Device Division created this months cover to show that microprocessor technology can be related through graphic simplicity for total understanding by the layman. For those interested in further information on Rockwell's PPS series microprocessors, contact the Microelectronic Device Division, 3310 Miraloma Ave., P.O. Box 3669, Anaheim, CA. 92803 or phone (714) 632-3729.

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CIRCLE NO. 8 ON INQUIRY CARD

MICRO-MATH

by Bruce A. Scott

An article in the December issue of INTERFACE magazine discussed the number system used in microcomputers. This article continues the discussion by telling you how the microcomputer manipulates the binary number system to perform arithmetic. Understanding these basic concepts will help you when you try to write software for your own microcomputer.

Computer arithmetic suffers from two constraints. First, the number system used in the microcomputer is limited to two distinct numbers, 0 and 1. Second, the microcomputer is limited in the performance of arithmetic operations. It can add. It usually cannot subtract, multiply or divide directly.

The microcomputer adds by obeying an add instruction with addition hardware. It has no subtraction hardware. It obeys a subtract command, if there is one in the instruction set, by performing twos complement addition with the addition circuitry. It multiplies the way that we were taught to multiply or by performing a technique called successive addition with the addition hardware.

Most of us learned arithmetic quite a while ago. The article begins by reminding us of things that we may have forgotten. It ends with two software routines and attendant explanations. One of the routines performs multiplication in the human way. The other routine performs multiplication as successive addition.

The number system that we learned in the early grades consists of ten unique characters; 0,1,2,3,4,5, 6,7,8, and 9. We were taught to add these numbers together to obtain a sum. We did this by arranging the numbers to be added in columns, adding the right column first, then moving to each adjacent column in turn. We also learned, and this is important here, that any time the total for an individual column could not be represented by one of the ten unique characters we were to write one of the characters below the column and carry another. Example one shows four problems in familiar addition. The significant feature here is the carry. Notice how it is generated and how it is represented as a number in parentheses.

EXAMPLE ONE

	(1)	(1)	(1)
1	1	51	559
+8	+9	+39	+403
9	10	90	962

Addition in the binary number system is similar. It employs the same rules but it causes us to create carries more frequently, or at least more easily, because of the limited number set 0 and 1. Any time a column total requires some character other than 0 or 1, a carry has been created. Example two shows three problems in addition in the binary number system.

EXAMPLE TWO

00 000 000	10 101 010	10 100 101
+01 010 101	+01 010 101	+01 010 101
01 010 101	11 111 111	11 111 010

We humans are able to perform binary subtraction in a similar way. We arrange the numbers in columns, find the differences in the first column at the right, and continue with successive columns to the left until we have found the remainder.

If the number that we are subtracting is larger than the number that we are subtracting it from, we increase the size of the second number by borrowing.

Example three shows one base ten subtraction problem and three base two subtraction problems.

EXAMPLE THREE

1*		
562	01 010 101	11 111 111
-271	-00 000 000	-10 101 010
291	01 010 101	01 010 101

1*1*
11 111 010
-10 100 101
01 010 101

The notation 1* in example three is used to show the need to borrow from the left.

Micro-processors do not include subtraction hardware. Some, not all of them, include the instruction subtract in their vocabulary. But they cannot directly perform the action of subtraction. They are enabled to subtract with a technique called twos complement addition. Example four shows three numbers and their twos complements.

EXAMPLE FOUR

Number	00 000 000	10 101 010	10 100 101
Twos Complement	00 000 000	01 010 110	01 011 011

Twos complements should not be confused with the instruction complement. The complement instruction changes every bit of the number that is being complemented. 1s are changed to 0s. 0s are changed to 1s. The twos complement is somewhat more selective.

Twos complements are formed by examining each bit starting with the least significant bit at the right end of the number. The least significant 1 bit is the dividing line. All of the 0s at the right of the least significant 1 bit are left as 0s. All of the bits to the left of the least significant 1 bit are changed either from 1 to 0 or from 0 to 1.

Twos complement addition is performed by adding the twos complement of the number to the other number in the problem. This may be a little clearer if we recall some arithmetic terms. Subtraction is the process of taking one number away from another. The number that we are taking away is called the subtrahend. The number that we are taking the subtrahend away from is called the minuend.

We perform twos complement addition by finding the twos complement of the subtrahend and adding it to the minuend. The end result is the same answer when we ignore any carries that may be formed to the left of the most significant bit in the original problem.

Example five shows each of the minuends used in example three. This time, the twos complement of the subtrahends are used and addition is performed. Notice that the resulting answers match.

EXAMPLE FIVE

01 010 101	11 111 111	11 111 010
+00 000 000	+01 010 110	+01 011 011
01 010 101	01 010 101	01 010 101

The multiplication process is the same in both number systems, binary and decimal. The arithmetic is substantially easier in binary.

We were taught to multiply base ten numbers by memorizing a multiplication table for the ten characters in our conventional number system. We learned two relationships that are useful in base two.

Multiplying any number by 0 creates a product that is 0. Multiplying any number by 1 creates a product identical to the number being multiplied. 3 x 0 = 0, 5 x 0 = 0, 10110 x 0 = 0, 3 x 1 = 3, 5 x 1 = 5, 10110 x 1 = 10110.

We multiply with a number consisting of more than one digit by working with one digit at a time. If we want to multiply 1234 x 321, we multiply first by the least significant digit of the multiplier, 1. We obtain a partial product identical to the multiplicand, 1234. Then we multiply by 2 creating a partial product of 2468. Finally we multiply by the most significant digit of the multiplier, 3, to get a partial product 3702. We write the partial products below each other shifting each partial product one position to the left of the one above it. The procedure resembles example six.

EXAMPLE SIX

Multiplicand	1234
Multiplier	x 321
Partial Product	1234
Partial Product	2468
Partial Product	3702
Product	396114

Binary multiplication is performed in the same way. The obvious difference here is that each partial product is either 0 or it is identical to the multiplicand.

Consider example seven. Here, the multiplicand 10110 is multiplied by 101. Look at each of the partial products in example seven and follow the multiplication that caused it.

EXAMPLE SEVEN

```
  10110
  x 101
  10110
 00000
10110
1101110
```

Our first example of a software routine performs multiplication following the general rules that we implied above. It examines the least significant bit of the multiplier. If it finds a 1 it adds the multiplicand into the product register. If it finds a 0, it jumps over the addition sequence. It shifts the multiplicand one position to the left and tests the next more significant bit of the multiplier.

The routine tests the bits of the multiplier starting with the least significant bit. It uses the rotate instruction to perform the test by shifting the multiplier toward the right and into the carry flag. Each time the instruction is performed, the multiplier is shifted one position to the right.

If the bit being tested is a 1, the carry flag will be set. The next instruction checks the condition of the carry bit and if it does not encounter a set carry flag jumps over the addition sequence.

Figure one lists the mnemonics of the routine with comments to help you follow the multiplication as the microcomputer performs it. One little trick that seems to help unravel routines is to determine which registers and memory cells are involved in the routine, chart them and simulate the behavior of the microcomputer by following each of the instructions personally entering appropriate numbers into the chart with a pencil as they occur in the routine. This routine uses registers A, B, C, D, and E. It does not use any memory cells.

It might be helpful if we define the purpose of each of these registers and say something about how they are used before we look at the routine.

Register A is the accumulator. The microcomputer that I use, the Altair 8800, performs all of its arithmetic and rotate instructions with the accumulator. This makes it necessary to shift into the accumulator to perform an operation and then shift back to get out of the way of the next operation.

Register B is the iteration counter. Each time the routine jumps back to look at another bit of the multiplier, the number in register B is decreased by one. The number in this register will be zero and the zero flag will be set when the routine has examined all eight bits of the multiplier.

Register C accepts the multiplicand from peripheral device 072. It provides it to the accumulator when needed and accepts it from the accumulator after it has been shifted and used for forming the partial product.

Register D accepts the multiplier from the same peripheral device. The multiplier is shifted to the right once before register D receives it the first time. It is shifted, rotated, once every time that register D provides it to the accumulator and receives it again. Each shifting allows the testing of one of the bits in the multiplier.

Register E holds zero initially. If the multiplier provided by the peripheral is zero, register E puts zero into the accumulator as the correct product for any multiplicand. Register E normally provides its content to the accumulator where it is added to by the shifted multiplicand as dictated by the multiplier.

```
000  MVI B      Put eight into register B
001  010
002  MVI E      Put zero into register E
003  000
004  IN         Put the multiplicand provided by
005  072        peripheral 072 into register C
006  MOV C,A
007  IN         Rotate the multiplier from 072 into
010  072        register D
011  RRC
012  MOV D,A
013  JNC        If the previous step did not set the
014  021        carry flag, jump to address
015  000        000 021
016  MOV A,C    Add the multiplicand to the
017  ADD E      product forming in register E
020  MOV E,A
021  MOV A,C    Rotate the multiplicand one bit
022  RLC        position to the left
023  MOV C,A
024  MOV A,D    Put the remaining multiplier bits
                into the accumulator
025  DCR B      Decrease the contents of register
                B by one
026  JNZ        If DCR B did not set the zero flag,
027  011        jump to 000 011
030  000
031  MOV A,E    Output the product on peripheral
032  OUT        device 072
033  072
034  JMP        Jump to address 000 000 and
035  000        start again
036  000
```

FIGURE ONE

This first multiplication routine causes the microcomputer to perform multiplication the way that we were taught to do it. The microcomputer's advantage is not the ability to do something that we cannot do. Its advantage is that it takes so much less time to do it.

The microcomputer performs each of its instructions so quickly that we can afford to write software that will require it to work inefficiently.

For example, multiplication as we have just performed it and a technique called successive addition produce the same arithmetic answer. Successive addition adds a number to itself as many times as it is told to do so by another number. The first number takes the place of the multiplicand. The second number is the replacement for the multiplier.

If you added the number four to itself three times you would get the sum of twelve. This is the same answer that you get when you multiply four times three. You do not normally choose to find the answer by successive addition because it is a tedious, time-consuming process. The microprocessor dotes on these iterative processes.

Figure two is the listing of the mnemonics necessary for the iterative successive addition routine. Compare this routine with the routine shown in figure one.

The successive addition routine requires registers A, B, and C. Register A operates as the product register. Register B holds the multiplicand. Register C holds the multiplier initially and operates as the iteration counter.

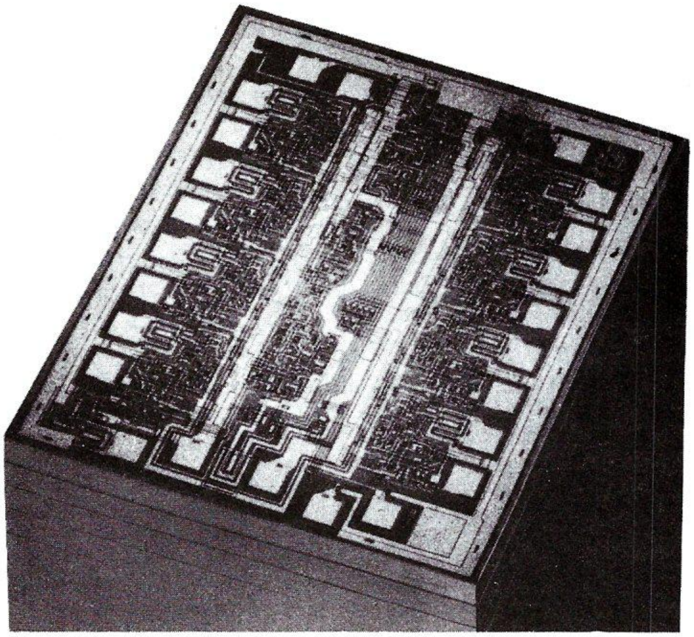
```
000  IN         Put the multiplicand into register B
001  072
002  MOV B,A
003  IN         Put the multiplier into register C
004  072
005  MOV C,A
006  CPI        Does the multiplier equal zero?
007  000
010  MVI A      Put zero into the product register
011  000
012  JZ         If the multiplier equals zero, jump
013  022        to 000 022
014  000
015  ADD B      Add the multiplicand to the
                product register
016  DCR C      Decrease the multiplier by one
017  JNZ        If DCR C did not set the zero flag,
020  015        jump to 000 015
021  000
022  OUT        Announce the product on
023  072        peripheral device 072
024  JMP        Jump to 000 000 and start again
025  000
026  000
```

FIGURE TWO

A comparison of the two routines leads to a few conclusions. Successive addition and conventional multiplication produce the same answer for the same problem. Successive addition is somewhat simpler in concept. Fewer registers are required for successive addition than are necessary for normal multiplication.

These last two conclusions are true for these routines as they are presented here. It seems probable that a little cleverness can change the length of either routine and its complexity.

I leave the improvements to you for your entertainment with the sincere hope that what has been said here will prove helpful while you are writing your own software routines. ◻



Microcomputer Applications

Serial Data Communication Part 1

by Terry Benson
Field Applications Engineer, Intel Corp.

This series of microcomputer application articles is intended to give an insight into possible uses of microcomputers. The applications discussed are intended to be tutorial as well as thought provoking. Hopefully, some of the application ideas discussed will spark your interest enough so that you can expand on the ideas or develop some of your own applications using the techniques described.

If you have read the two previous articles, "Timing by Use of Microcomputers" and "Serial Communication with Software," you should be familiar with techniques for using microcomputers in applications traditionally reserved for hardware. Although microcomputers can provide the basis for a low cost home computer system, they have wide ranging applications in areas not related to actual "computer" functions. Typical of the cost effective applications of microcomputers is in use as a controller—primarily areas where logic design has been used in the past (yes, maybe even relay logic!). This month, following the ideas developed in the previous articles, we will complete a program that can be used to eliminate hardware for serial data communication. As has been discussed, the microcomputer can be used to perform parallel-to-serial and serial-to-parallel data conversions. The program can then eliminate the need for a hardware device known as a UART (Universal Asynchronous Receiver/Transmitter) or a USART (Universal Synchronous/Asynchronous Receiver/Transmitter). It should be understood, however, that for this application the microcomputer system will be limited in one way: the microcomputer cannot perform any other function during data conversion. This drawback can be easily overlooked in a system that requires low cost and is not limited by processing throughput. (In the next article I will discuss alternate methods that can overcome this drawback.) In fact, in some applications it may be necessary to add a UART or USART to increase throughput.) One benefit of using the programmed approach for data communication is that a program can also be used to effect "automatic baud-rate synchronization." This means that any terminal using ASCII coding, operating at *any* transmission rate, can be connected and operate reliably as long as the rate is fixed. This can be useful even when operating with a teletype. Teletype timing, controlled by mechanical movements, can change, albeit slightly, as the unit "ages." This means that readjustment of the teletype will be required periodically. A method for eliminating this periodic maintenance will be described in this article. The primary benefit of this feature is that the baud rate, or transmission rate, of the terminal need not be known. This allows operation with any terminal without mechanical or electrical modifications.

Serial to Parallel Conversion

We will begin the generation of the transmit-receive program by illustrating a method for receiving serial data and converting it to eight bit parallel data. Last month I described the transmit portion and suggested that you try your hand at the receive portion. Since there is really no wrong answer (as long as the program works), my approach may be different from yours but in reviewing mine you may get ideas for other program techniques—and that's just what these articles are intended for.

The flow chart in figure 1 illustrates the steps that need to be performed to read the 8 serial bits and accumulate an 8 bit parallel word. Register C will be used to save the intermediate results and it must initially be cleared. Register B will be used as the bit counter and is set to 8. The next two blocks of the flow chart create a delay while waiting for a character to begin. (Note that this loop will be executed indefinitely if no character occurs. Therefore, the processor cannot do anything else—but this problem can be eliminated by means of interrupt implementation which will be covered in a future article.)

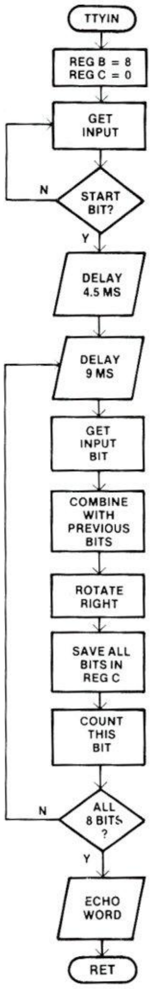


FIGURE 1. Flow Chart of TTY Receive Routine

After the start bit is recognized, a delay equivalent to one half of a bit time is introduced (½ x 9.09 ms = 4.55 ms; do you recognize that number from the last article?). This places the time window midway in the start bit. From this point a delay equivalent to one bit time (9.09 ms) places the bit strobe midway in first bit. Subsequent bits will also be interrogated at about the midpoint of the bit time. After each delay, the 8 input bits are read from the input port. The 7 most significant bits will be masked off (set to zero) so that the previous bits stored in register C can be combined with the new input bit. This is accomplished by performing a logical "OR" of the earlier bits with the present bit. After all bits are combined, the bits collected up to this point are rotated right with the least significant bit (B0) going to the most significant bit position (B7). The bits not yet accumulated are zero and occupy the least significant bit positions. (Figure 2 illustrates the bit location after each rotate.) The rotated bits are saved in register C for the next loop. At this point, the bits are counted to see if all eight have been received (actually the bit counter, register B, is decremented for each of the eight bits until it reaches zero). If it does not go to zero, more bits still have to be read. When register B is decremented to zero, both the accumulator and register C contain the accumulated 8-bit word.

The final block, although not required as part of the serial-to-parallel conversion routine, is provided so that an "echo" of the received character can be output back to the teletype. In most terminal configurations the data transmit and data receive circuits are independent of each other. This means that operation of the keyboard will not directly cause the character to be printed. Only the microcomputer system controls what is printed. This communication scheme is known as *full duplex*. (Operation where transmit and receive are connected on a common circuit is known as *half duplex*.)

After	BIT POSITION IN REG C							
Rotate	7	6	5	4	3	2	1	0
1ST	B1	0	0	0	0	0	0	0
2ND	B2	B1	0	0	0	0	0	0
3RD	B3	B2	B1	0	0	0	0	0
4TH	B4	B3	B2	B1	0	0	0	0
5TH	B5	B4	B3	B2	B1	0	0	0
6TH	B6	B5	B4	B3	B2	B1	0	0
7TH	B7	B6	B5	B4	B3	B2	B1	0
8TH	B8	B7	B6	B5	B4	B3	B2	B1

FIGURE 2. Location of Bits After Each Bit is Received

Figure 3 shows the program steps that are used to implement the serialization routine. It is important to note that, while the bit time delay that is generated is primarily a function of the delay subroutine (DLAY9), there is a 62 clock, or 31 usec, period added to each bit cycle (with the 8080 operating at a 2 MHz clock rate). This extra delay is in the section called LOOP (lines 6 through 13) in figure 3. This suggests that the delay subroutine itself should be slightly less than the total 9.09 ms. The same condition must also be accounted for in the serial transmit routine and, thus, it is desirable for this portion of the two routines, transmit and receive, to be equal. Although slight variations can be tolerated at teletype data rates, higher transmission speeds may require more accurate timing. Remember that this is critical for the 9 ms routine but the 4 ms routine need be only approximately half of a bit time. Using the technique of calling the 4 ms routine twice means that the 4 ms timing loop can actually be slightly less than one half of a bit time.

```
Line
No.  Cycles  Label    Operation      Comments
 1    10     TTYIN:   LXI B, 800H    ;CLEAR C, SET B = 8
 2    10     STRB:    IN PORT1       ;GET DATA
 3     7              ANI 1          ;MASK OTHER 7 BITS
 4    10              JNZ STRB       ;TRY AGAIN IF NOT START BIT
 5    17              CALL DLAY4     ;DLAY 4.5 MS
 6    17     LOOP:    CALL DLAY9     ;DLAY 9 MS
 7    10              IN PORT1       ;GET NEXT BIT
 8     7              ANI 1          ;MASK UNUSED BITS
 9     4              RRC            ;BO TO B7, B7 to B6
11     5              MOV C, A       ;SAVE IN REG C
12     5              DCR B          ;DECREMENT BIT COUNTER
13    10              JNZ LOOP       ;GO GET REMAINING BITS
14    17              CALL TTYO      ;ECHO CHARACTER
15    10              RET            ;8 BIT CHARACTER IN REG C
16    17     DLAY9:   CALL DLAY4
17    10              JMP DLAY4
```

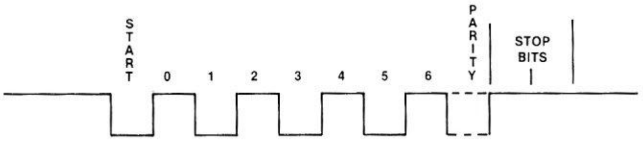
FIGURE 3

Program for Converting Serial Input to a Parallel 8-Bit Word

Automatic Synchronization

Now that the microcomputer is providing the bit timing for both data transmit and data receive it is quite easy to modify the data transmission rate. Simply changing one instruction in the delay routine (the instruction that initializes the counter) bit rates of from 110 baud to 4800 baud can easily be generated. One other method of changing the bit timing loop is to have the microcomputer store the present value in a RAM location that can be initialized by the program. This eliminates the need for modifying the program for different applications. The value that will be used for the initialization of the counter can actually be determined by first sampling the data that is received from the data terminal.

A method for determining the counter value would be to time the period of each data bit. This requires that a character of alternating one's and zero's be sent from the data terminal. The character "U" consists of the desired configuration (see figure 4). When determining the bit timing it is necessary to average the time of the negative bit (zero) with the time of the positive bit (one). It also makes sense to evaluate as many bits as possible and take an average of those bits. This is most easily accomplished by timing the start bit and the first three data bits. (Eight bits might seem more appropriate but the sense of the parity bit is not consistent from terminal to terminal—and division by 4 is easier to perform than division by 5, 6, or 7).

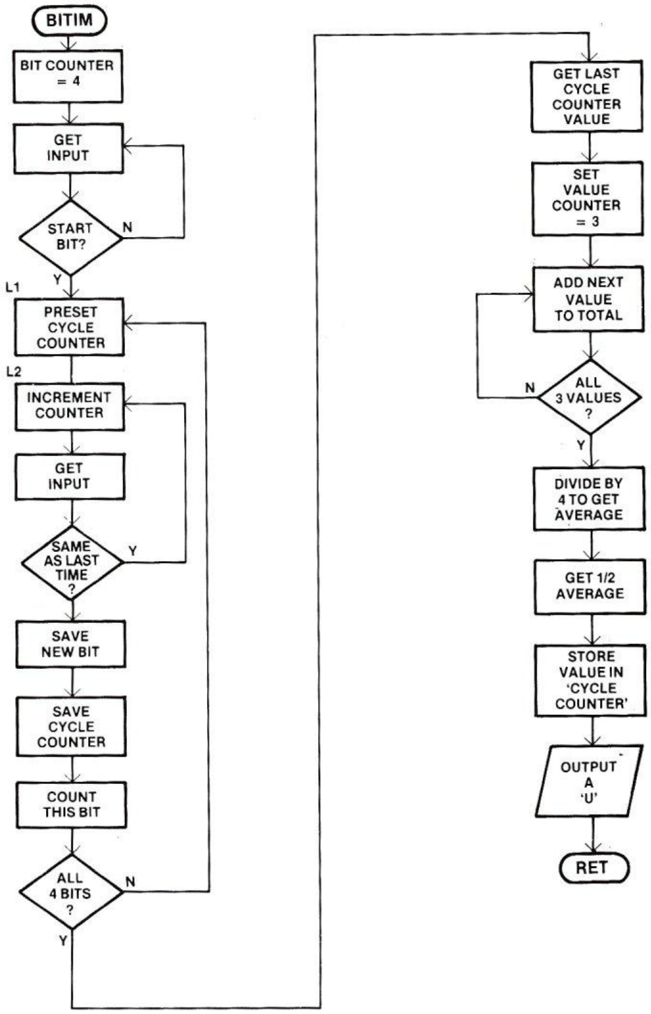


ASCII "U"

FIGURE 4

The flow chart illustrated in figure 5 uses timing loop techniques that have been discussed in previous articles. A significant point to remember is that the timing loop counts the number of times that a certain section (loop) of the program is executed and the final count must be multipled by the time it takes to execute that loop. However, if the delay program that uses this value has *exactly* the same number of clock cycles as used in the loop, there is not even a need to perform a multiplication. This suggests that some care should be exercised to provide identical timing cycles for the set-up routine that initially times the bits and the delay routine that will use the value for bit-time delays. This point will be discussed in more detail when all routines are combined together.

Another point that should be noted about the flow chart is that the loop counts, which are 16 bit values, are stored in the memory stack as they are accumulated. After the first four bits have been timed, the four values are added together with the 16 bit add command (DAD). (Yes the 8080 can add two sixteen bit numbers in a single instruction.) The average is then determined by dividing the sum by 4 (2 right shifts). The average is then divided by 2 to provide a routine to delay one-half of a bit time.



FLOW CHART FOR DETERMINING BIT TIMING

FIGURE 5

Complete Program

In order to produce a complete transmit/receive program that incorporates automatic baud rate synchronization, four major subroutines have been discussed:

1) Parallel-to-serial conversion;
2) Serial-to-parallel conversion;
3) Timing delay routine; and
4) Bit timing set-up routine.

Next month I will illustrate a complete program that incorporates all four of these subroutines. You might want to try the complete program yourself and compare it to mine next month. In fact, if you have some ideas on changing or simplifying my techniques, please do so. The complete program may even illustrate some new methods for performing the four subroutines. ◻

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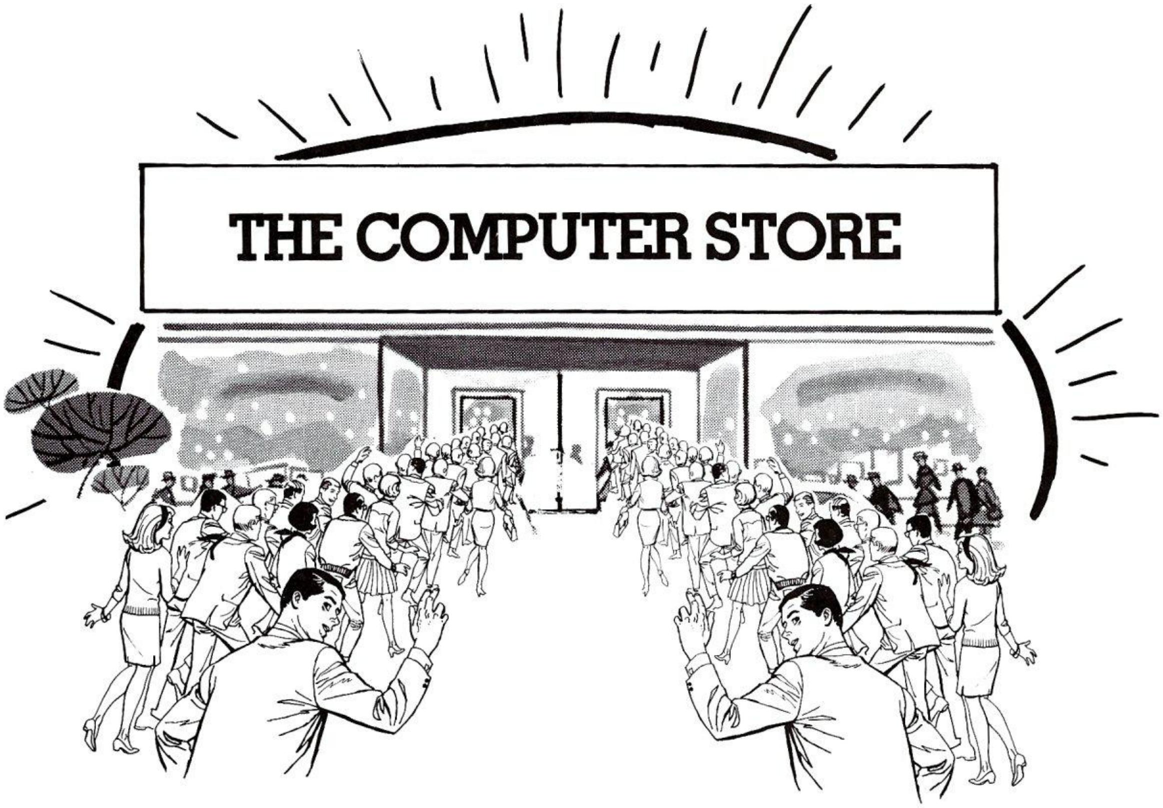

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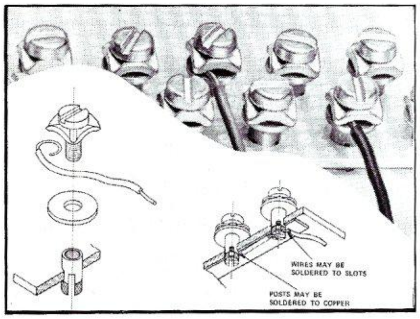

WIRES MAY BE SOLDERED TO SLOTS
POSTS MAY BE SOLDERED TO COPPER

CIRCLE NO. 90 ON INQUIRY CARD

SCREW TERMINALS PROVIDE EASY CIRCUIT BOARD CONNECTIONS

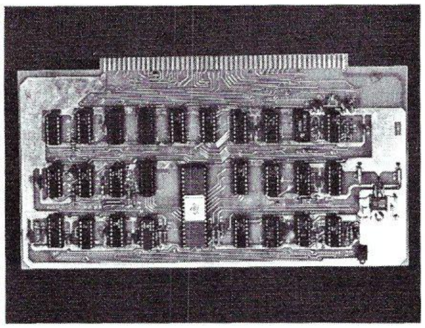
A new screw terminal, from Vector Electronic Company, allows convenient circuit board connections for single-conductor or standard wire from 20 to 30 gauge. Called the Model T122, 0.312 in. diameter by 0.430 in. high terminals are easily pressed into 0.154 in. diameter holes and staked with a simple punch. Located anywhere on 0.0625 in. thick circuit boards, the terminals provide easy termination without expensive and bulky terminal blocks.

The upper end of the terminal has a shaped square washer with concave entries which prevent wires from "skidding-out" from under the screw as it is tightened. The lower end is knurled and cross-slotted for soldered-in wires on solder connections to circuit-board pads.

The tinned brass terminals are priced at $90.00 per thousand; evaluation quantities are available at $1.40 per package of ten, and $12.00 per package of 100. A free sample is available from Vector Electronic Co. T122 screw terminals are available off-the-shelf from Vector, or through their distributors throughout the U.S. and Canada.

The Model T122 screw terminals complement Vector's accepted line of production and prototype electronic packaging hardware. Vector is a major manufacturer of terminals, connectors, printed circuit boards, card cases, enclosures, and complete packaging systems.

Vector Electronic Company, 12460 Gladstone Ave., Sylmar, CA. 91342; (213) 365-9661, TWX (910) 496-1539.



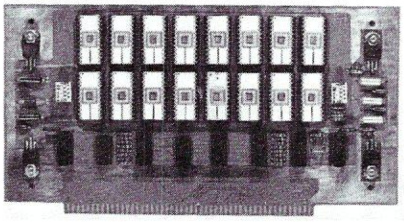
CIRCLE NO. 91 ON INQUIRY CARD

AM 6800 card is 8800 Compatible

MRS is offering a product which allows owners of an Altair 8800 to develop systems with Motorola's MC6800 MPU. The AM6800 card is an Altair 8800 compatible device which allows one to take advantage of all the best features of each processor in software through alternating processors in the same program.

The one board, pin compatible card, requires no modifications to the Altair and will not interfere with normal execution of 8080 programs. The MC6800 gains control via software command, one instruction. Return control is accomplished either by the front panel stop switch or through software, one instruction. It will operate with either fast or slow, static or dynamic memories. MC6800 MPU status signals are brought out on unused bus lines (jumper option), i.e., 01 & 02 clocks, VMA, R/W lines for system development. The 8080 processor card remains in the computer to handle all front panel controls.

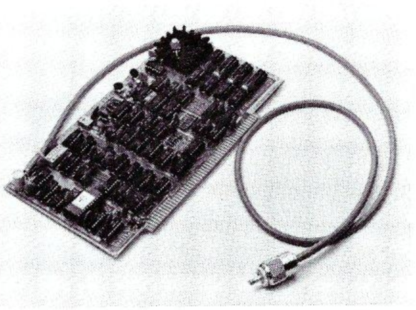
AM6800 pricing: Complete Kit, $148.75 plus tax. Complete kit except MC6800, $97.75 plus tax. For further details write MRS, P.O. Box 1220, Hawthorne, CA 90280



CIRCLE NO. 92 ON INQUIRY CARD

NEW EPROM BOARD OFFERS UP TO 4K BYTES

New EPROM board offers up to 4K bytes with up to 4K bytes of Read Only Memory. The 2K/4K EPROM Board model MB-3, provides the addressing and control circuits for 1 to 16 EPROMs. The board is designed for 1702As, but MM5203s may be used with minor modifications. It fits a dual 50, 0.125" edge connector and is plug compatible with the ALTAIR 8800 and IMSAI 8080 microcomputers. Features include: (1) Dip switch selection of address and wait cycles. (2) Protection against reverse voltage. (3) Four regulators; two positive and two negative. (4) Sockets for all ICs and EPROMs. (5) Plated-through board with gold-plated contacts. Complete kit (less EPROMs) $65.00; (with 8/1702As) $145.00; (with 16/1702As) $225.00; wired and tested (with 8/1702As) $179.00—all are plus tax prepaid. This kit will be offered for group purchase by SCCS. For further information contact Solid State Music, 2102A Walsh Ave., Santa Clara, CA. 95050 (408) 246-2707.



CIRCLE NO. 93 ON INQUIRY CARD

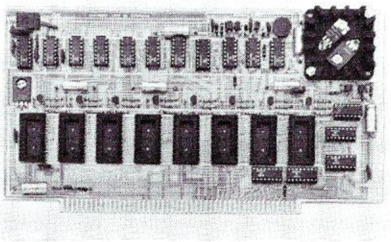
NEW DISPLAY MODULE FROM PROCESOR TECHNOLOGY

The Altair/IMSA compatible VDM-1 generates sixteen 64-character lines in a large easy-to-read font with both upper and lower case letters. It contains 1K (1024) bytes of random access memory, to which the processor can read or write, just as though the memory were an integral part of the system. As the information is written in, contents of the on-card memory are displayed instantly without interrupting the operation of the processor.

Once the processor provides the display status parameters, the VDM-1 can be made to "scroll" its display upwards or downwards. A built-in timer allows scrolling at about 4 lines per second, eliminating complicated timing program routines. At top speed, the display scrolls through a dump of 65K of memory in two minutes; that's about 1000 lines per minute!

Multiple programmable cursor circuitry is built in. All 1024 cursors can be displayed at one time or begin anywhere in the display. Thus, the VDM-1 can display white-on-black or black-on-white—perfect for many video games! The VDM-1 also features EIA Video output for any standard video monitor, or a television repair shop can easily modify your own TV set.

Kit price, $179.00 with premium quality low profile IC Sockets. For further details contact Processor Technology, 6200 Hollis Street, Emeryville, CA 94608



CIRCLE NO. 94 ON INQUIRY CARD

8K BYTESAVER by CROMEMCO

The Cromemco Bytesaver VDM-1 is a full speed 8K ROM board with built-in PROM programmer. It plugs directly into the Altair 8800 computer. The Bytesaver may be used with 2304 or 2308 ROMs or with 2704 or 2708 PROMs. Both the 2704 and the 2708 are high-speed devices (450 nanosecond access time) that allow the 8080 to run at full speed during memory read. A PROM in any of the eight sockets on the Bytesaver board may be programmed under software control. A protect switch is used to disable the PROM programmer to prevent accidental PROM programming. For further details contact Cromemco, One First St., Los Altos, CA 94022.

CIRCLE NO. 95 ON INQUIRY CARD

NO NOISE—NO PAPER DUMB VIDEO TERMINAL INTERFACES TO COMPUTER

Anaheim, CA—While the rest of the world concentrates on so-called "intelligent terminals," Lear Siegler appears to have taken a step in the other direction by introducing a low-cost terminal—but only because it's smart to be dumb.

The ADM-3 video terminal offers a standard 960-character display in 12 lines of upper case characters. It also is the only video terminal in its price class to make available an optional 24-line, 1960-character display.

The standard 59-key office-type keyboard permits generation of the complete USASCII set. The ADM-3 displays upper case in high contrast characters in a standard 5x7 dot matrix.

Data entry is at the bottom line of the ADM-3 screen. Advancing to a new line causes the entire data page to scroll upward, typewriter style. Full control of the display is provided by Clear Screen, Carriage Return, Line Feed, and Space Bar keys. Backspace and character overwrite capability allow display editing. End of line is announced by an audible tone to alert the operator to go to the next line manually.

The ADM-3 contains both a 20mA current loop interface and the EIA standard RS232C interface for direct or data communication connection to any standard computer port.

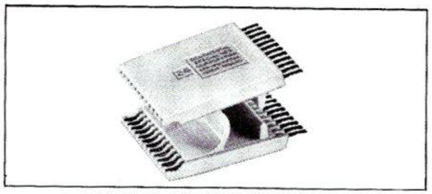
An EIA RS232C extension connector, included at no extra charge, permits easy interfacing with most asynchronous serial printers for hard copy recording of the video display information. This bidirectional extension port may also be used to daisy chain multiple data terminals, or to interface a magnetic recorder for storing larger messages.

A switch panel next to the keyboard allows operator selection of the ADM-3 operating mode, either full or half duplex. The transmit and receiver speed is selectable from 75, 110, 150, 300, 600, 1200, 1800, 2400, 9600 to 19200 bauds.

Word format is also tailored to the application with a choice of standard 9, 10, or 11 bit words with odd, even or no parity, plus one or two stop bits.

The compact ADM-3 video terminal weighs only 25-pounds, and measures 12.5 high x 15.5 wide x 19 inches deep. It consumes only 70 watts for economical operation. The ADM-3 Video Terminal sells for $995 or less depending on the quantity ordered.

Complete details and specifications on the ADM-3 (Dumb) terminal may be obtained from the Marketing Department, Lear Siegler, Inc./EID, Data Products, 714 North Brookhurst St., Anaheim, CA 92803, (714) 774-1010.



CIRCLE NO. 96 ON INQUIRY CARD

CONTINENTAL SPECIALTIES CORPORATION INTRODUCES NEW PROTO-CLIP™—24

Continental Specialties Corporation, New Haven, Connecticut has developed and is now marketing a new 24-pin IC Test Clip—Proto-Clip™ 24.

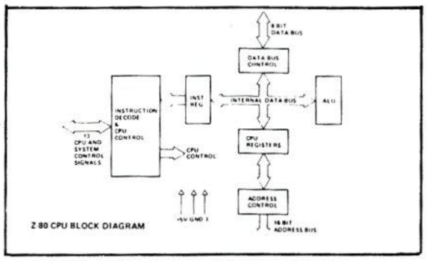
Patterned after Continental Specialties' other popular Proto-Clips (PC-14, for 14-pin DIP's and PC-16 for 16-pin DIP's) the new, PC-24 sells for only $8.50—lowest priced 24-pin IC test clip made today.

This mini-troubleshooter offers a narrow throat; perfect for bringing IC leads up from high density printed circuits boards—practically eliminating accidental shorts while testing live circuits. It can be used to inject signals and wire unused circuits into other boards.

Scope probes and test leads lock onto the unique gripping contact teeth, freeing hands for other work. Non-corrosive nickel/silver contacts provide simultaneous wiping action, low resistance connections to IC leads.

Overall plastic construction eliminates springs and pivots, while the unique molded web (patent pending) insures thousands of operations.

The PC-24 is available from your continental specialties distributor or contact Continental Specialties Corporation, 44 Kendall St., P.O. Box 1942, New Haven, CT. 06509. (203) 624-3103 or 351 California St., Box 7809, San Francisco, CA. 94119, (415)



Z-80 CPU BLOCK DIAGRAM

CIRCLE NO. 97 ON INQUIRY CARD

ZILOG INC., Los Altos, CA. introduces new dimension in microcomputer technology—Z-80CPU with 4, 8 and 16-bit operations.

The Z-80CPU microprocessor offers many powerful features and innovations at low cost. The device, a single chip, n-channel processor, combines high speed (20% faster than an 8080A), and a repertoire of 158 instructions including those of the 8080A plus software compatibility, to attain greater system design economy and performance. Also featured are built-in refresh for dynamic memory, single 5V power supply, 17 internal registers, direct indexing, relocatable software and single phase TTL clock.

For further information, contact Zilog, Inc., 170 State St., Suite 260A, Los Altos, Ca. 94022.

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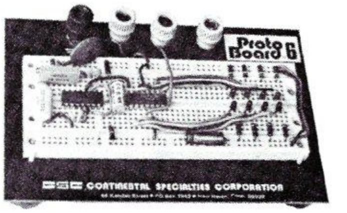
CIRCLE NO. 98 ON INQUIRY CARD

NATIONAL "PACER" KIT

The "PACER" Kit is a complete microprocessor learning tool for industrially-oriented engineers. It includes all the National Semiconductor PACE MPU Components as well as the keypad, display, case, power supply, etc. The "PACER" with its Assembler "PAC I" and Memory Expansion "PAC II" options can also function as a design tool for small to medium software system needs. The kit contains a self-instruction User and Assembly Manual along with a full supply of National's PACE Design literature.

Another feature of the "PACER" is a debug program that allows memory, examination and modification as well as HALT, RUN and BREAKPOINT functions. The "PACER" Kit can be obtained through your nearest Hamilton/Avnet industrial distributor office.



CIRCLE NO. 99 ON INQUIRY CARD

PROTO-BOARD® 6 LOW PRICE SOLDERLESS BREADBOARD KIT

Continental Specialties Corporation, New Haven, CT has introduced Proto-Board® 6, the lowest priced solderless breadboard kit on the market today. This compact kit can be assembled in minutes and offers 6 14-pin DIP IC capacity for basic breadboarding, testing and building applications.

Selling for only $15.95, the American made PB-6 includes one QT-47S solderless breadboarding socket,* two QT-47B Bus Strips, four 5-way binding posts, a metal ground and base plate, rubber feet to prevent scratching work surfaces, all nuts, bolts and screws, plus complete easy-assembly instructions.

The PB-6 lets the user test and build circuits without soldering or patch cords; all interconnections between components are made with common #22 AWG hook-up wire. This quality breadboarding kit includes 630 component tie points at less than 2.5 cents each. It measures 6" long by 4" wide.

For further information, contact your Continental Specialties dealer or Continental Specialties Corporation, 44 Kendall St., New Haven, CT 06509, (203) 624-3103; 351 California St., San Francisco, CA 94119, (415) 421-8872.

*Patent Design #235,554

HARDWARE REPORT

by S. Wilcox

The new TV DAZZLER color graphics interface for the ALTAIR 8800 and IMSAI computers is aptly named. Designed to operate with a standard color television as the display device, its operation has to be seen to be appreciated. And when seen, it is truly dazzling to see and mind boggling to think of the possible applications.

We have built a DAZZLER from the kit, and have only good things to say about it. The DAZZLER is one of the highest quality kits that we have encountered. It is built on two printed circuit boards that plug into the ALTAIR/IMSAI buss structure. The boards are beautiful, with full silk screening for component location and identification to include even the component values. The glass-epoxy boards are double sided with plated through holes and gold plated edge contacts. There are sockets for each of the 72 integrated circuits as well as the plug terminated ribbon cable used to interconnect the two boards. The full use of the sockets is a feature that we applaud and highly recommend for all integrated circuits. Construction is easy and straightforward due mainly to the fact that the silk screening and complete varnish solder mask make it almost impossible to insert components incorrectly.

Board #1 generates a complete composite color NTSC video signal through a length of RG174/U, 52 ohm miniature coax, for injection into the TV's video amplifier. However, we must agree with the DAZZLER designers at Cromemco that the safest and most cost effective method of connecting to the TV receiver is through a simple RF modulator made by ATV Research (see address and price at end).

Board #2 has the duty of communicating with the computer's buss structure through two output ports and one input port. Data is then extracted from memory for video conversion through a high speed direct memory access controller at a rate of up to one million bytes per second. The beauty of the DMA concept for this application is that once the DAZZLER is enabled it will continue to generate a picture based on the block of memory selected regardless of the current program that is being executed. The best applications though would involve executing a program that could modify the contents of that block of memory currently allocated to the display.

The DAZZLER has great versatility in how it displays the data presented to it and in how it obtains this data. There are two resolution modes with different data interpretations. In the "normal" resolution mode, adjacent line elements of the picture are generated from information 'stolen' from the host memory by the DMA controller. The X 4 resolution mode allows each bit of the memory data to turn on or off a single picture element. Both modes allow for full color presentations. Normal resolution color data comes from coded data read from memory; X 4 resolution color data comes from the particular code word that is output to the DAZZLER control channel. The amount of data displayed, regardless of resolution mode, is selectable as either 512 bytes or 2K bytes. Therefore, a X 4 display for 2K bytes generates a 128x128 element picture.

To generate meaningful TV pictures, the memory data to be read must be coded properly.

The following table shows the code scheme for normal resolution. One memory word is divided into two 4 bit codes to represent two picture elements.

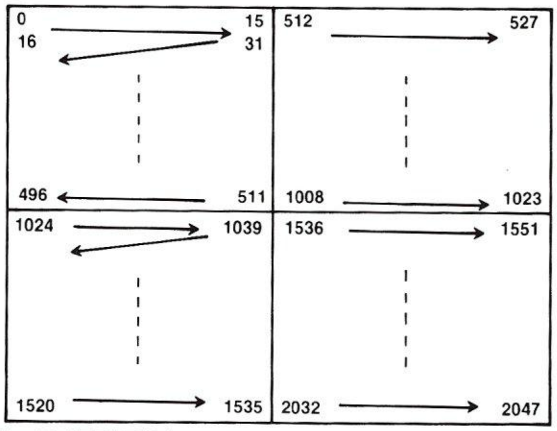
D0	D1	D2	D3	D4	D5	D6	D7
RED	BLUE	GREEN	HI/LO	RED	BLUE	GREEN	HI/LO

$\underbrace{\text{D0 – D3}}_{\text{picture element}}$ $\underbrace{\text{D4 – D7}}_{\text{adjacent element}}$

The X 4 mode has a different geometric interpretation.

D0	**D1**	**D4**	**D5**
D2	**D3**	**D6**	**D7**

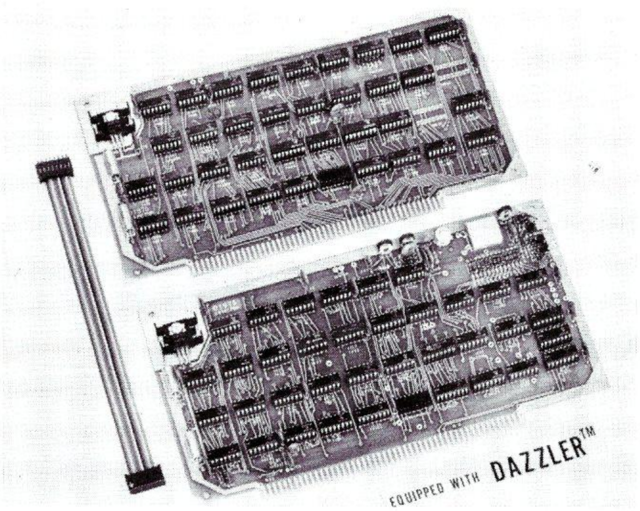
The 2K byte picture is called out of memory as four 512 byte pages that are displayed as quadrants and scanned as shown. If only 512 bytes are selected for display, then only the first quadrant is used.



The DAZZLER is one of the most exciting computer options yet. There is some real potential here for some great graphic "imagineering" and it seems certain that we will hear more about DAZZLER applications in the future.

The DAZZLER is available from:

CROMEMCO
One First St.,
Los Altos, CA 94022
Price—$215 kit, $350 assembled



RF modulator to convert video output to TV channel tuner input is available from:

ATV Research
13th & Broadway
Dakota City, NEBR 68731
Price—$8.50 kit model #PXV-2A

MEMORY EXPANSION

by S. Wilcox

Is there anyone out there who has enough memory for their system? Probably not, so here is a hardware technique that will double the capacity of a memory board. 4K boards can become 8K; 1K can go to 2K etc. Basically all that has to be done is to stack up DIP memory I.C.'s that have compatible electrical and mechanical characteristics.

Address and data busses connect memory chips horizontally; extend the busses vertically by soldering a second memory piggy back on the original. Leave the proper chip select pin (if the device has more than one) unconnected, bent out to the side. All the new chip select CS pins can be carefully connected together.

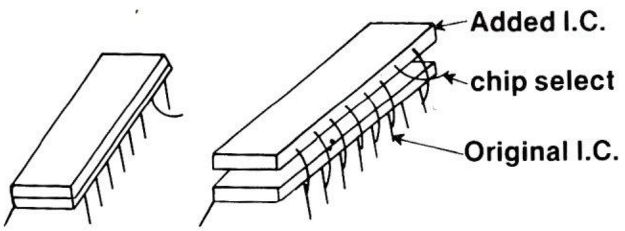
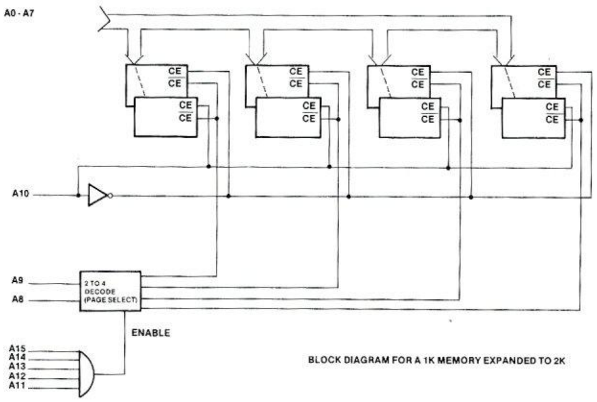


FIGURE 1

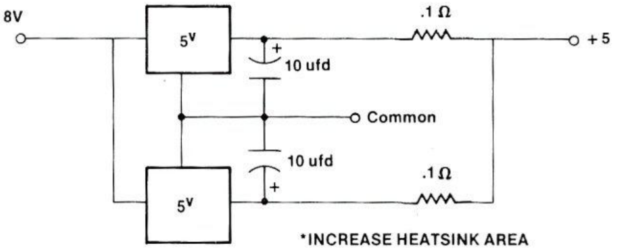
Next, the chip select decoding circuits will have to be modified slightly to accommodate the added capacity. The generalized scheme is shown in Figure 2.



BLOCK DIAGRAM FOR A 1K MEMORY EXPANDED TO 2K

FIGURE 2

Finally, you must consider the effect of the memory addition on your power supply or the onboard regulators. The power draw by the board will now be essentially double its previous value. Do not parallel voltage regulators directly, as one will hog the load. Either use the circuit of figure 3 or divide the on board loads for an additional regulator by cutting traces as appropriate. Also be sure to increase the value of the bypass capacitors. ▣



*INCREASE HEATSINK AREA

FIGURE 3

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CIRCLE NO. 10 ON INQUIRY CARD

AN INTRODUCTION TO THE BY-LAWS OF THE SOUTHERN CALIFORNIA COMPUTER SOCIETY

by Ward Spaniol

The Society is governed by its by-laws which are presented in this issue. The official existence of SCCS began with the unanimous adoption of the by-laws on September 21, 1975. Prior to this date the Society operated as an informal organization under the direction of a steering committee whose officers were:

Jerry Silver, Chairman
Pearce Young, Vice Chairman
Don Tarbell, Secretary
Hal Lashlee, Treasurer

There was unanimous consent among the members of the committee that the primary task was a statement of goals and objectives. The principal author of this statement is Judge Pearce Young, although it was amplified by many suggestions. Some most notable additions were proposed by Jon Walden.

The growth of the Society has been so phenomenal that most of the membership has never heard of the steering committee nor seen the by-laws. For every member on the date of adoption we now have ten. This is a fact every member can take pride in. The strength of this Society is the interactions between members and their capability to assist each other. The Officers and Directors are a necessary evil, to be tolerated so long as the refreshments are satisfactory, INTERFACE is delivered on time, and somebody finds the missing membership applications. You have made this Society what it is and the by-laws represent all our high ambitions of what it is to become.

In the very near future we will be proposing a number of amendments. Chief among these is a section extending the proper recognition and stature of the growing number of chapters. We recognize the ability of the chapters to provide local and regional service in a far more timely manner than the Society can. Other areas will be explored as the Society matures and its ultimate character appears.

Finally the by-laws represent the ultimate definition of our agreement with each other. They outline what each member has an absolute right to demand from the Society, its Officers and Directors. Each member must be the ultimate judge of the degree to which the Society has fulfilled its obligations. The evidence that the membership has fulfilled its obligation is a direct challenge to the Officers and Directors to demonstrate an even greater degree of dedication toward the principles established by these by-laws.

BY-LAWS
SOUTHERN CALIFORNIA COMPUTER SOCIETY

ARTICLE I

The name of this organization is the Southern California Computer Society, hereinafter referred to as the "Society", or "SCCS".

ARTICLE II

The purposes for which this organization is formed are:

Section 1. Specific and primary purposes.

The specific and primary purposes are to promote and encourage a community interest in the computer arts and sciences with particular emphasis upon defining, enlarging upon and applying the computer to education and to the social, scientific, and environmental problems of society. To this end the Society, with the consent of a majority of the Board of Directors, may cooperate with and provide services to any local, state or federal governmental body or agency, or to any school, college, or university.

Section 2. General purposes and powers.

The general purposes and powers are:

A. **To exchange** and disseminate information among the Society members concerning the computer arts and sciences.

B. **To provide** technical assistance to other members of the Society in those computer projects which are not undertaken for pecuniary gain or profit including but not limited to hardware, software, and computer programming.

C. **To publish** books, newsletters, magazines, and other periodicals for the benefit and education of the Society members and the general public.

D. **To conduct** and sponsor seminars, lectures, and courses relating to the computer arts and sciences.

E. **To maintain** a Society library consisting of books, films, catalogues, tapes, programs, journals, and other materials relating to the computer arts and sciences.

F. **To develop** and maintain computer centers and laboratory workshops for the members of the Society and the general public including provisions for time-sharing operations. Subject to the provisions of Article II, Section 1, the computer centers and their capabilities would be available to the Society members, governmental agencies, educational institutions, and those members of the general public whose use is non-profit in nature as defined and enumerated in these by-laws.

G. **To engage** in any activity not inconsistent with the provisions of these by-laws.

Section 3. Non-profit status.

The Society is not organized, nor shall it be operated for pecuniary gain or profit, and it does not contemplate the distribution of gains, profits, or dividends to its members, and is organized solely for non-profit purposes. The property, assets, profits and net income of the Society are irrevocably dedicated to scientific, educational, and community services, and no part of the profit and net income shall inure to the benefit of any officer, director, member, or individual. If the Society should ever be dissolved or cease to exist, its assets remaining after payment of all debts and liabilities of the Society, shall be distributed to a non-profit fund, foundation, corporation or governmental body that is organized and operated exclusively for scientific, educational or community service purposes and has established its tax exempt status under the Internal Revenue Code and the Revenue and Taxation Code.

Section 4. Additional purposes.

A. To buy, lease, rent or otherwise acquire, hold, or use, own, enjoy, sell, exchange, lease as lessor, mortgage, deed in trust, pledge, encumber, transfer, or trust or otherwise dispose of any and all kinds of property, whether real, personal, or mixed, and to receive property by gift, bequest or devise.

B. To enter into, make, perform and carry out contracts of every kind for any lawful purpose with any person, firm, corporation or governmental agency.

C. To solicit, receive funds and property by gift, will or otherwise, from individuals, trusts, corporations, associations, societies, institutions, or other organizations or authorities desirous of contributing to the purposes for which this Society is formed.

D. Notwithstanding any of the above statements of purposes and powers, this Society shall not engage in activities that in themselves are not in furtherance of the purposes set forth in Section 1 of this Article II, and nothing contained in the foregoing statement of purposes shall be construed to authorize the Society to carry on any activity for the profit of its members, or to distribute any property, gains, or profits to any of its members.

ARTICLE III

The County in this State which is the principal office for the transaction of the business of the Society is Los Angeles County.

ARTICLE IV

MEMBERS

Section 1. Members

There shall be three classes of members of the Society, regular members, honorary members, and sustaining members. There shall be no limit to the number of regular members.

Section 2. Regular members.

The regular members of the Society shall consist of those persons who, upon the date of the adoption of these by-laws shall have contributed ten dollars ($10.00) to the Society. Thereafter regular members shall be those persons who pay such dues as are determined by the Board of Directors. Regular membership in the Society without the payment of dues may be granted by the Board of Directors in those cases of financial hardship. Persons who upon the date of the adoption of these by-laws shall have paid $10.00 to the Society shall also be known as "Charter Members" and their names shall be affixed to these by-laws. A "Charter Membership" confers no additional rights and privileges than are enjoyed by any subsequent regular member. Regular memberships are not transferable.

Section 3. Honorary members.

Honorary members shall consist of those persons, firms, or corporations who, in the opinion of the Board of Directors and by their majority vote have made substantial contributions toward the advancement of the computer arts and sciences. An honorary member will not be entitled to vote on any matter affecting the Society or its officers, directors, and members unless he is also a regular member.

Section 4. Sustaining members.

Sustaining members shall consist of those persons, firms, or corporations who, in the opinion of the Board of Directors, have made important contributions to the Society in the form of moneys, real or personal property, or technical assistance. A sustaining member will not be entitled to vote on any matter affecting the Society or its officers, directors, and members.

Section 5. Admission to membership.

No person shall be excluded from membership because of age, race, religion, sex, sexual preference, color, or creed. The only qualification for membership shall be the payment of such dues or waiver of dues as determined by the majority vote of the Board of Directors. No membership may be terminated for any reason other than the non-payment of dues or a violation of these by-laws. Termination of membership for a violation of these by-laws must be by a three-fourths vote of the regular members constituting a quorum.

Section 6. Meetings of the regular members.

The annual meeting of the regular members of the Society shall be held at 1:00 p.m. on the third Saturday of September of each year. **Other regular meetings shall be called and held at a time and place to be selected by the Board of Directors.** Notice of each meeting of regular members shall be mailed to each regular member at his address shown on the Society records no less than 10 days before the meeting. If for any reason the annual meeting of the regular members is not held on the above date, the Board of Directors shall call a special meeting of the regular members in lieu of the annual meeting, which meeting shall be held not later than 30 days after the date set for the annual meeting.

Section 7. Voting.

All regular members shall have equal voting rights and each regular member shall be entitled to cast one vote except in the election of the Board of Directors of the Society. In the election of the Board of Directors each member shall have one vote for each vacancy to be filled on the Board. At any election of directors each regular member may cumulate his votes and give one candidate a number of votes equal to the number of directors to be elected, or may distribute his votes among as many candidates as he thinks fit. The candidates receiving the highest number of votes in descending order are elected to fill the positions of directors to be elected.

Any regular member who cannot attend the annual meeting or any meeting called for the election of officers or members of the Board of Directors or amendments to the by-laws may vote by absentee ballot provided he notifies the Secretary of the Society no less than 10 days prior to said meeting.

ARTICLE V

DIRECTORS

Section 1. Number and qualifications.

The authorized number of directors of the Society shall be 21 (including the President) until changed by amendment of these by-laws adopted by the members. Each director of the Society shall be **a regular member** and if a person **ceases** to be a regular **member** of the Society he shall also cease to be a **director.**

Section 2. Election and term of office.

Directors shall be elected at each annual meeting of the regular members, or at any special meeting of the members held in lieu of the annual meeting. All directors shall hold office until their respective successors are elected, except in case of resignation, death, disability, or removal of a director.

[The President of the Society shall, at least 60 days prior to each annual meeting of the members, appoint from the regular members of the Society a committee of at least seven (7) members who shall, at least 30 days before each annual meeting, submit the names of those persons nominated by the committee to be members of the Board of Directors for the ensuing year.]

At the annual meeting any ten (10) regular members may nominate one or more members to be directors for the ensuing year.

At the annual meeting the election of directors shall be by ballot. Those persons receiving the highest number of votes shall be the directors for the ensuing year.

Section 3. Removal of directors.

A director may be removed from office by the affirmative vote of two-thirds of the regular membership of the Society.

Section 4. Vacancy

A vacancy on the Board of Directors caused by death, resignation, disability, or removal shall be filled by a majority vote of the remaining directors.

Section 5. Meetings.

A majority of the authorized number of directors shall constitute a quorum for the transaction of business.

Meetings of the Board of Directors shall be held regularly at a time and place as determined by a majority vote of the Board. Special meetings of the Board of Directors shall be held at such times and places as directed by the President.

The Secretary shall attend all meetings of the Board of Directors and shall record minutes which shall be open to inspection by any regular member. [Any regular member **may attend meetings of the Board of Directors.**

Section 6. Powers of the Board.

Subject to the limitations of these by-laws the business and affairs of the Society shall be controlled by the Board of Directors including but not limited to the following:

A. To conduct, manage and control the affairs and business of the Society.

B. To receive on behalf of the Society gifts, bequests, and devises in the form of property or moneys.

C. To formulate policies and programs which will be presented to the regular members for vote.

ARTICLE VI

OFFICERS

Section 1. Officers.

The officers of the Society shall be a president, a vice-president, a secretary, and a treasurer. From time to time a majority of the regular members may vote to create other officers. These may be temporary or permanent as the membership should vote. If permanent, the duties and responsibilities will be listed as an amendment to these by-laws.

Section 2. Election.

Officers shall be elected at each annual meeting of the regular members, or at any special meeting of the members held in lieu of the annual meeting. All officers shall hold office until their respective successors are elected, except in case of resignation, death, disability, or removal of an officer.

The **president of the Society shall, at least 60 days prior** to each annual meeting of the members, appoint from the regular members of the Society a committee of at least seven (7) members who shall, at least 30 days before each annual meeting, submit the names of those persons nominated by the committee to be officers for the ensuing year.

At the annual meeting any ten (10) regular members may nominate one or more members to be officers for the ensuing year.

At the annual meeting the election of officers shall be by ballot. The person receiving the highest number of votes for the office nominated shall hold that office for the ensuing year.

Section 3. Removal and resignation.

An officer may resign or may be removed from office by a **majority** vote of the regular members. Vacancies will be filled at the next regular meeting of the Society by nomination and election from the general membership.

Section 4. Duties.

A. President

The president shall be **the executive officer** of the Society and, subject to control of the Board of Directors, **shall have general supervision, direction, and control of the affairs of the Society.** He shall be a member of the Board of Directors and shall preside at all meetings of members and at all meetings of the Board of Directors. At the annual **meeting** of **members** he shall **make a report of the general business** of the Society during the previous year. The president shall appoint committees and shall be an ex officio member of all committees.

B. Vice-President

The vice-president shall, in the absence or disability of the president, perform all the duties of the president, and when so acting shall have all the powers of, and be subject to the restrictions on, the president.

C. Secretary

The secretary shall keep at the **principal office of the Society** a book of minutes of all meetings of the directors and of the members. He shall maintain a membership book for the Society showing the name and address of each regular member. He shall assign a membership number to each regular member. He shall conduct the official correspondence of the Society and shall perform such other duties as may be designated by the Board of Directors.

D. Treasurer

The treasurer shall have general charge of the financial records and accounts of the Society and shall keep and maintain adequate and correct books of account showing the receipts and disbursements of the Society with such depositaries as are designated by the Board of Directors. He shall render to the **president or** Board of Directors on request statements of the financial condition of the Society, provided that statements shall be rendered at least quarterly.

ARTICLE VII
MISCELLANEOUS

Section 1. Execution of documents.

The Board of Directors may authorize any officer or agent to enter into any contract or execute any instrument in the name of and on behalf of the Society, **and this authority may be general** or confined to specific instances; and, unless so authorized by the Board of Directors, no officer agent, or other person shall have any power or authority to bind the Society by any contract or engagement or to pledge its credit or to render it liable for any purpose or amount.

Section 2. Inspection of by-laws.

The Society shall keep in its principal office the original or a copy of these by-laws, as amended or otherwise altered to date, certified by the secretary, which shall be open to inspection by the members at all reasonable times.

Section 3. Rules of order.

The rules contained in Robert's Rules of Order, revised, shall govern all members' meetings and directors' meetings of the Society, except in instances of conflict between Robert's Rules of Order and the articles of incorporation or by-laws of the Society or provisions of law.

ARTICLE VIII

These by-laws may be amended only in the following manner:

A. The Board of Directors, whenever two-thirds of the directors shall consider it necessary, shall propose amendments to the by-laws.

B. Ten percent (10%) or 100 of the regular members (whichever is less) may petition the Board of Directors to amend the by-laws. The petition shall clearly set forth the Articles and Sections to be amended, and thereafter the Board of Directors must propose said amendments to the general membership for vote within 30 days.

C. Any proposed amendment shall be submitted to the entire regular members in written form no less than 15 days before a vote shall be taken.

D. Any amendment shall be valid to all intents and purposes, as part of these by-laws, when ratified by the vote of a majority of the regular members or by two-thirds of the regular members present at a meeting called for that purpose. Written notice of such meeting shall be given to all regular members no less than 15 days before the meeting.

Adopted September 21, 1975, by unanimous vote of the members present.

CHARTER MEMBERS OF THE SOUTHERN CALIFORNIA COMPUTER SOCIETY

Gerald Silver
Joe Hughes
Donald E. Tarbell
Roy Fultun
George Tate
Hal Lashlee
Ray DeLong
Ward Spaniol
Lou G. Fields
William D. Roch
John French
De Ekstrand
Ronald B. Keele
Lois H. Heiser
Richard S. Heiser
Pearce Young
Jon Walden
Barry Gott
Russ Lotter
Richard Culbertson
Howard Spencer
Jeff Landry
Lewis E. Fite
Carl David Todd
Art Childs
Lloyd Rice
Ruben Loshak
Mike Stern
Erik E. Kepka
Ron Rogers
G. Scott Morris
Chris Leach
Ronald Carlson
Audrey V. Keele
John A. Borders
Marvin Perlman
Larry Press
Robert Baskin
Roger Hall
Sandra Hall
George Rowe
Mike Dent
Chris King
Frank Tendick
Gerri E. Rooney
Scott Wilcox
Pat Amornvitikivacha
Douglas L. Penrod
Ron Estes
Grant Runyon
Bill Pfeiffer
Robert Smith
Tom Rockwell
Linda Rockwell
Bud Maron
Daniel L. Pastell
David Walden
Rudolf Hirschmann
Bruce P. Holmen
Angel Bravo
Steve DeGarmo
Derek McColl
Mike Hayes
Doug Kubler
Katherine Kubler
Andy Gilman
Ralph Wells
Robert Barker
Charles Fete
Bob Hall
Pat Mullican
Lelah Mullican
Rich Steincross
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Gerard J. Aucoin
Ray B. Mould
Johnnie Keim
Ray Perez
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Owen Sherrill
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Lorin Mohler
Craig Hjorth
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Ira Baxter
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Patricia Wood

Back To Baroque By Way Of The Dim Savage Future

by John Whitney

Electronic Engineering Times in late January reports there are six or seven thousand computers in homes already. Many, they say, are used for electronic games but many more serve no useful purpose other than "to familiarize the user with their capabilities." I have a pregnant idea what to do with some of those idle ones. And their idle owners?

It is not a matter of child's play to build or program a computer. In fact, learning to write programs is like learning to play a musical instrument. Both require effort, persistance and learning by disciplined self-training. These are all very respectable traits which we can find among musicians and programmers alike. I wish I might find an authoritative sociologist's study, say, of 15th thru 19th century musical developments in Europe. Such a study would probably show something about the self-discipline and the intellectual energies of just plain people from those musical decades that might tell us about creative energy in our own time.

In the first place, I believe the amateur musician played an important role in the exploration of European musical form. Of course, music prospered at chapel, court and countryside in those days, and the many active forms of dance and courtly ceremony required professional composer and musician. But still I suspect the musical anthropologist would show us other reasons for the many regional bursts of creative enthusiasm and energy such as the Flemish "schools" of polyphony or the later cascade of keyboard music around the era of Scarlatti in Spain, Portugal and Italy. The anthropologist, contradicting the musical historian, might have less to say about the dozens of genius masters and instead stress that restless quality of the human intellect. Or he might simply seek to translate the physical need to climb mountains into its artistic and intellectual equivalent. Craftsmen created a family of superior keyboard instruments (superior like a 64K RAM chip) and their productivity explored a flurry of interest to cultivate that extraordinarily fecund musical format—the sonata (perfect hardware/software tradeoff). Scarlatti and others opened wide new stylistic and technical possibilities and a kind of land rush was started (a bit elitist and aristocratic but a rush just the same). Everyone on his block (the king's block, that is) began to outdo his neighbor composing sonnets and sonatas. "So Domenico composed five hundred and fifty essercizi—beat that."

Now mightn't something like that sort of friendly rivalry happen on our block next year? For example, aren't there a few in my own neighborhood already willing to beat me hands down with their own color computer graphic compositions any day? I hope so. I believe probabilities of this kind are at least a partial answer to *Electronic Engineering Time's* worry about the "purposeful" use for all the computational know-how and hardware being distributed into homes.

This idea need not strain anyone's credulity. If musical metaphor is valid at all then a computer in one home may be likened to a piano in another; with like intellectual, spiritual and aesthetic justifications.

I believe there are other ways in which examples of music are useful to help one understand some of the formal design problems of computer graphics. Since music is the supreme art of architectonic pattern constructed on a time base, *of course* music should set the best example for our study of visual pattern which we plan to construct on a time base. So let us scrutinize music carefully.

At the outset we know the musician's aural spectrum to be an undifferentiated and continuous spread of frequencies, say, from twenty to twenty-thousand cycles. Yet this apparently homogeneous continuum is not continuous at all. Harmonic relationships interactively transfigure this spectrum. Harmonic phenomena create discontinuities which coalesce into nodules of tension, anticipation and resolution that deform this otherwise smooth continuum. Whole number or harmonic nodes scattered throughout the spectrum create order-disorder proclivities, centers of emotional focus which distort an otherwise smoothly ascending texture. In fact sounding tones over the span of just one octave persuades the ear that we are nearer a return back to the start than we are advanced along any straight line of upward continuous ascension.

I want to stress that it is this particular discontinuity, not really any other quality of the audio spectrum, that constitutes the raw material of the composer's art. Not pitch, texture, rhythm and meter. Not frequency, intensity and density as most 20th century modernists have wanted us to believe. That is to say, no matter how we divide the spectrum into steps we find an hierarchy of perceptual values that distinctly rank each step. It is the composer's cunning or intuition or even mindless exploitation of his hierarchy that is the primary source of rhythmic vitality and emotional content of music. The composer, however, must cooperate with these natural harmonic forces or see his strategies defused by them. He cannot work his will against, nor exercise insensitivity to the charge and discharge. He cannot escape the dominion of the gravitational force of harmonic moment.

It is of great importance to us as a corollary to all the above, that a visual domain of harmonic consequence has become accessible through computer graphics. With the graphical display rooted upon coordinate mathematics it is only natural that a great variety of periodic interference pattern can be produced. The motive now exists for the computer composer to discover his way into this diverse domain of dynamic visual form structured out of two and three dimensional harmonic periodicity. This domain abounds with tonic centers of focus as in music. And this domain will render up an equivalent rhythmic and emotional content as in music. I think we will soon learn to cooperate anew with natural harmonic forces in hitherto unexplored visual territory. All we have to go on today is theory and the work of a very few pioneering individuals. If my vision is anything near 20/20, the future, however is not so dim, nor so savage. Discovery and spreading ideas are among the uses of a computer society—will you not agree?

Next month I will describe some discoveries I have made regarding an harmonic theory for visual design. Scarlatti would have found these theories raw, uncooked and savage compared to the sophistication of music theory and established practice in his own 18th century. ◻

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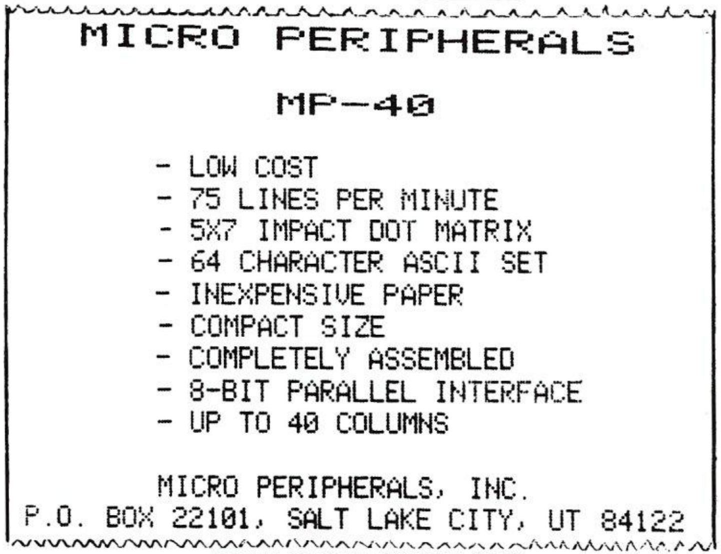

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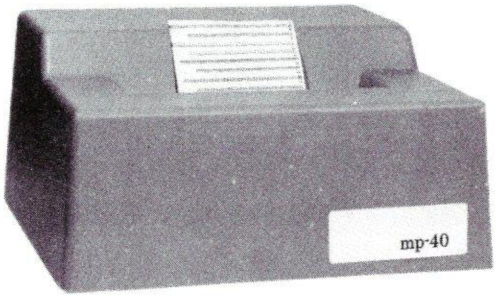

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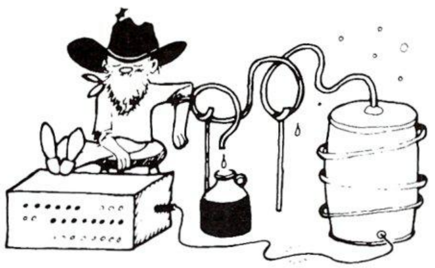
GAMES & THINGS



by Tom Rugg

Hello again, game fans. This month we'll look a little further into random number generators (RNGs) and how they can be used, and then, buried at the end of this article, there's some important news for you Star Trek freaks.

In the March issue, we talked about what a random number generator is and why it is necessary to use one in most games (i.e., to avoid having the computer do exactly the same thing against you every time). We also looked at three common types of RNGs and showed how to program the first type. The three types were:

1. the "fixed range integer" type
2. the "variable range integer" type
3. the "zero to one floating point" type

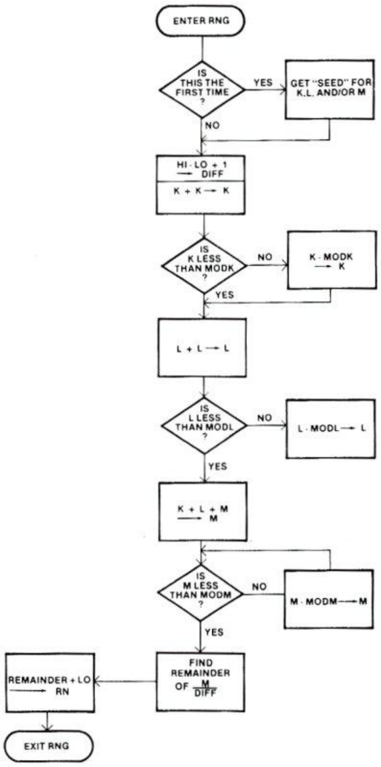
This time we'll look more closely at the second type, which is probably the most useful to have available when writing game-playing programs.

PROGRAMMING A "VARIABLE RANGE INTEGER" RNG

The purpose of a variable range integer RNG is to provide a random integer within a range we specify when we call it. If the game requires the throwing of a die, we need an integer from 1 to 6. If the game involves a deck of playing cards, we may need a random integer from 1 to 52. Also, in many game-playing programs, there is the situation in which the program evaluates what its best move is (such as in chess or checkers) and finds that there are several equally good moves. When this happens, the RNG can be called to select one of them at random, causing the program to play differently in identical situations. This kind of approach is needed to prevent the human opponent from knowing what the program will do next. A variable range integer RNG is very handy for this sort of requirement.

As you may notice in Figure 1, the heart of this RNG is the same as the fixed range integer RNG that was in the March issue. The only real difference is the additional logic to convert the random number (M) into an integer in the specified range. This simply requires dividing M by DIFF, which is 1 larger than the difference of the HI and LO values which define the range to be used. The remainder from this division is added to LO to produce RN, which is the random number to be returned to the calling program. Of course, HI has to be greater than or equal to LO, and the difference between HI and LO must be less than MODM.

FIGURE 1



The same comments mentioned before apply for K, L, M, MODK, MODL, and MODM. That is, MODK, MODL, and MODM should be prime numbers of the form (8n + 3) or (8n + 5) that are slightly less than one-third of the largest number that will fit in a word (10909, 10891, and 10861 were suggested for a 16 bit machine). K, L, and M need to be initialized to values that are not too close together, and at least one of them should be initialized to a variable "seed" (such as a value from the time of day or a number entered by the human player) to prevent the same sequence of random numbers from being generated every time.

FIGURE 2

```
          SUBROUTINE SHUFF(DECK)
          INTEGER DECK(52), RN(3), TEMP
          RN(1) = 1
          RN(2) = 52
C       GO THRU THE DECK FROM 1 TO 52, EXCHANGNG
C       EACH CARD IN TURN WITH A RANDOM ONE.
          DO 100 N = 1,52
          CALL RNG2(RN)
C       RN(3) IS NOW A RANDOM NUMBER FROM 1 to 52
          J = RN(3)
          TEMP = DECK(N)
          DECK(N) = DECK(J)
          DECK(J( = TEMP
100     CONTINUE
        RETURN
        END
```

Figure 2 shows an example of a FORTRAN subroutine that can be called to shuffle a deck of cards. It uses a variable range integer RNG named RNG (how's that for a clever name?). The RNG is called using a three word array (called RN in this example). The first word of the array contains the LO value of the range, the second word contains the HI value, and the third word will have the random number returned in it. The program that calls this SHUFF subroutine passes its "deck" in a 52 word array. The same logic can easily be adapted to shuffle different sized arrays.

For those of you with access to one of the big IBM blue boxes, Figure 3 is a listing of this variable range integer RNG coded in IBM 360/370 Assembler Language. It uses the rightmost 12 bits of the time of day (in hundredths of seconds) as its seed for M, thus getting a number from zero to 4095. Note that it's all right to let M start at zero, but K and L must not.

FIGURE 3

```
RNG        CSECT
***  ESTABLISH REG 12 AS BASE REG
***  AND PERFORM STANDARD OS/VS
***  REGISTER SAVING
           USING    *,12
           STM      14,12,12(13)
           LR       12,15
           ST       13,SAVEAREA + 4
           LA       8,SAVEAREA
           ST       8,8(13)
           LR       13,8
           B        * + 76
SAVEAREA   DC       18F'0'
***
***  GET 'SEED' FOR M THE FIRST TIME
***
FIRSTIME   BC       0,CONTINUE
***  MODIFY BRANCH AFTER FIRST TIME
           OI       FIRSTTIME + 1,X'F0'
           LR       2,1
***  ISSUE 'TIME' MACRO TO GET
***  TIME OF DAY IN HUNDREDTHS OF
***  SECONDS IN REGISTER ZERO
           TIME     BIN
***  ZERO OUT FIRST 2 1/2 BYTES, LEAVING
***  A NUMBER FROM ZERO TO 4095
           N        0, = X'00000FFF'
***  STORE SEED IN M
           ST       0,M
***  RESTORE PARAMETER PTR TO REG 1
           LR       1,2
***
***  GENERATE RANDOM NUMBER
***
***  LOAD REG 1 WITH ADDRESS OF PARAMETERS
CONTINUE   L        1,0(1)
***  LOAD 'LO' INTO REG 4
           L        4,0(1)
***  LOAD 'HI' INTO REG 5
           L        5,4(1)
***  SUBTRACT LO FROM HI
           SR       5,4
***  ADD ONE TO DIFFERENCE
           LA       5,1(5)
***
***  LOAD K INTO REG 7
           L        7,K
***  SHIFT LEFT 1 BIT (MULT BY 2)
           SLA      7,1
***  COMPARE WITH K'S MODULUS
           C          7,MODK
***  IF LESS THAN MODK GO TO STOREK
           BL         STOREK
***  IF GREATER, SUBTRACT MODK
           S          7,MODK
***  SAVE NEW VALUE OF K
STOREK     ST         7,K
***
***  LOAD L INTO REG 7
           L          7,L
***  SHIFT LEFT 1 BIT (MULT BY 2)
           SLA        7,1
***  COMPARE WITH L'L MODULUS
           C          7,MODL
***  IF LESS THAN MODL GO TO STOREL
           BL         STOREL
***  IF GREATER, SUBTRACT MODL
           S          7,MODL
***  SAVE NEW VALUE OF L
STOREL     ST         7,L
***  ADD K TO L IN REG 7
           A          7,K
***  ADD M TO SUM OF K AND L
           A          7,M
***  COMPARE WITH M'S MODULUS
CHECKM     C          7,MODM
***  IF LESS THAN MODM GO TO STOREM
           BL         STOREM
***  IF GREATER OR EQ. SUBSTRACT MODM
           S          7,MODM
***  GO COMPARE WITH MODM AGAIN
           B          CHECKM
***  SAVE NEW VALUE OF M
STOREM     ST         7,M
***
***  ZERO OUT REG 6
           SR         6,6
***  DIVIDE M BY DIFF
           DR         6,5
***  ADD LO TO REMAINDER
           A          6,0(1)
***  STORE RESULT IN CALLING PGM'S RN
           ST         6,8(1)
***
***  RESTORE REGISTERS AND
***  RETURN TO CALLING PGM
           L          13,4(13)
           LM         14,12,12(13)
           SR         15,15
           BR         14
***
***
K          DC         F'2000'
L          DC         F'7000'
M          DC         F'0'
MODK       DC         F'10909'
MODL       DC         F'10891'
MODM       DC         F'10861'
                   END RNG
```

STAR TREK NEWS

It's not really the purpose of this column to supply you with all the latest Hollywood gossip, but for Star Trek we'll make an exception. No, not for the Star Trek computer game, but for the Star Trek TV show and its many fanatic followers.

The big news is that plans are being made to film a Star Trek movie! It will be a feature length theater-type movie, not a "made for TV" production. Current plans call for filming to begin in mid-July. The name of the movie and even the final script are not yet decided on, but it looks like many members of the original cast and crew will be working on it.

Who knows? Maybe they'll have an 8080 chip controlling the ship's bridge. ◘

UP 'N RUNNIN'

by Stephen Tuenge

After beating my brains out troubleshooting a couple of Altair CPU Boards and a front panel that had gone berserk, I decided that there just had to be a better way. With the thought in mind that we all could benefit from the experience of others, I approached Art Childs at the January meeting of SCCS and suggested that INTERFACE devote a small section each month for members to relate the various symptoms they have run across in their home computers and what they had done to fix them. Also, I thought, it would be a good idea for SCCS to keep a library of the weird things that can go wrong, so that a member with a problem could at least be pointed in the right direction. By the end of the conversation with Art, I had somehow agreed to write the first article myself.

The objective of this article is not so much to set up a clinic, as to provide a meeting ground for the people with problems and those with answers: the success of the basic idea rests mainly on the willingness of those who have encountered problems and solved them to communicate their results to the rest of the world.

If you have had hardware woes and overcome them, let us know. Write up your experiences telling us what kind of machine you have, the symptoms it displayed, and what it took to fix it. Follow up with a brief explanation to point the way to others with similar problems. If your computer is on the fritz and has you stymied, write and tell us about it. The answer to your problem may already have been contributed by someone. Write to INTERFACE or to me personally including your address and phone, (Steve Tuenge, P.O. Box 3301, S. El Monte, Ca. 91733). Unless otherwise requested names will be used to give proper credit and to speed answers to those in need.

The following are a couple of the problems that led up to suggesting this article in the first place.

1. *System:* Altair 8800

Symptoms: Resets to 377 377 (octal)

Problem: System clock, ICQ a 74123 wasn't turning on fast enough.

Reasoning: A quick check showed that the address buss buffers were properly enabled and the address lines at the CPU really were all high. Without being able to check the internal functions of the CPU itself, it had to be temporarily assumed that the problem was somewhere else (actually that turkey cost $60 then so it had better be good!). Next all the voltages to the CPU were checked out, still nothing wrong. That left only the logic inputs and the clock to put the blame on, as the data buss wasn't involved. Using a logic probe, everything checked out OK. By now desperation had set in. What if it really was the 8080 that was bad? No, there must be something wrong with the clock, and sure enough, with a solid input on pin 1, ICQ showed a bad pulse risetime on the output. Changing the 74123 set it all to rights.

2. *System:* Altair 8800

Symptoms: After running any program, all of the occupied memory space was filled with an endless string of 172 004 172 004 . . . . . .

Problem: CPU not receiving valid inputs on the data buss. Open trace on CPU board at pin 8 of ICR.

Reasoning: Not knowing what's going on inside the 8080 made this a real mind blower at first. Using the same logic as before it was assumed that this was another case of Garbage In Garbage Out, and not a bad 8080. All the inputs to the CPU itself checked out all right. But, with the computer running the data input buss buffers were not being enabled even though the proper signal was present at pin 8 of ICR. From there it wasn't too difficult to find the open trace and repair it.

Rather than go on with another problem involving an Altair 8800, I feel that at this time the space would be put to better use in repeating the plea for information from all the hardware types that might have something to offer. While we are all in the process of learning about microcomputers and their common faults, why not avoid, if we can, duplication of effort. With the combined resources and knowledge available within SCCS membership, no problem should be unsolvable.

Cancer's warning signals:

1.
Change in bowel or bladder habits.

2.
A sore that does not heal.

3.
Unusual bleeding or discharge.

4.
Thickening or lump in breast or elsewhere.

5.
Indigestion or difficulty in swallowing.

6.
Obvious change in wart or mole.

7.
Nagging cough or hoarseness.

If you have a warning sign, see your doctor!

AMERICAN CANCER SOCIETY

This space contributed by the publisher.

Bits & Bytes

by Mike Teener

Well, it's still not here. But by the time you read this I will have an Altair 680. Or so I've been told. I have to admit that I'm more than a little bit underwhelmed by a four month (plus) delivery time. It better be worth it.

This month is just chuck full of interesting news, one of the best items being the availability of a FORTRAN compiler for the 8080. Control Logic, Inc., Nine Tech Circle, Natic, Mass. 01760 is advertising what appears to be an almost complete FORTRAN subset. It includes integer (32 bit), real (32 bit), and byte (8 bit) data types, two-dimensional arrays, blank common, logical IF statements, mixed mode arithmetic, functions and subroutines, data statements, formatted and unformatted I/O, and even analog I/O. They say it requires 24K bytes to run. Control Logic has been in the microcomputer business since 1971 and has an exceedingly large hardware and software catalog, but this item is a quantum jump.

Intel has two more numbers for you; 8048 and 8271. The 8048 is a new "low end" 8 bit micro. It's really not too useful for our game since the maximum program memory is 2K bytes and maximum data memory is 320 bytes. But it's still an interesting device because the chip has: (1) 1K bytes of ultraviolet erasable PROM, (2) 64 bytes of RAM, (3) a programmable interval timer, and (4) four 8-bit I/O ports. All on one chip. Just the thing to use as a controller for a fancy I/O device like a cassette or a floppy . . . but wait! That 8271 is going to be a *one* chip floppy disk controller. Rockwell already makes one, but it hasn't made much of an impact since it was intended for the PPS-8 system. The 8271, on the other hand is intended for 8080 and similar (like 6800) systems. This bears watching.

I finally got the detailed info on that Texas Instruments 9900 16-bit micro . . . and it looks very good. The chip itself only has three programmable registers; the program counter, status register, and the workspace pointer. The kicker is that the workspace pointer contains the address of the beginning of a 16 word area in memory that is used for general purpose registers. All the space not used for registers on the chip has been used for providing the best instruction set available on a one chip system. As far as the programmer is concerned, there are 16 general purpose registers that can be used in about as many ways as a PDP-11's registers. (Unfortunately, there is no "auto-decrement indirect" made so they can't be directly used as stack pointers.) The best part about having registers in memory is that you don't have to save them when you get an interrupt or enter a subroutine. All you have to do is change the workspace pointer and—PRESTO! You have 16 new registers. In addition to the neato registers you have multiply and divide, N-bit shifts, 16 and 8 bit arithmetic, a better conditional branch set than any other micro, and absolutely the best interrupt scheme in town—regardless of cost. Typical instruction times are: add (register to register) 4.7 microsecond, add (register to memory) 7.3 microsecond, multiply (register to register) 17.3 micro-second, Jump 2.3 to 3 microsecond. If you want software they've got assemblers, BASIC, FORTRAN, COBOL and a real-time disk operating system (that works).

A sign of the times . . . DEC is getting so many orders for their low-end products (DECwriters, LSI-11's) that they're starting a new, radical method of marketing . . . a catalog! Yes, folks, that's right. It's a slick, full color 140 page book with a flimsy yellow section for the order forms and shipping information. If you order using the catalog instead of the traditional sales office approach, you get a 5% discount. If you include payment with the order, you get an additional 4% off. Sorry, no credit cards.

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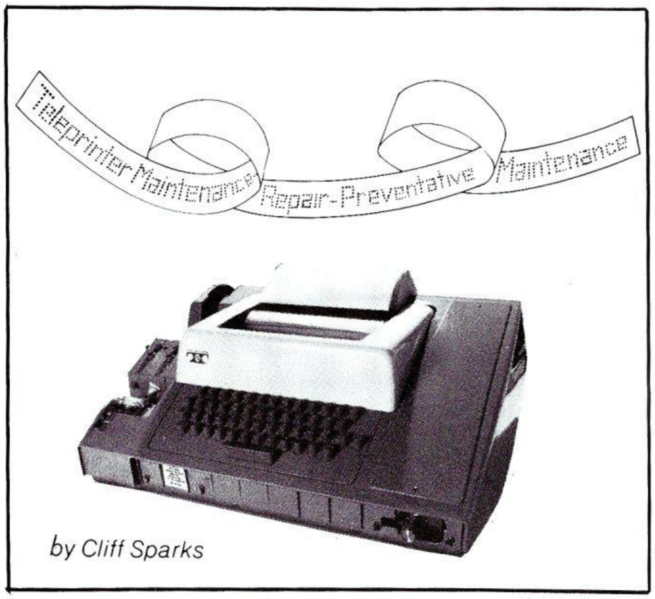
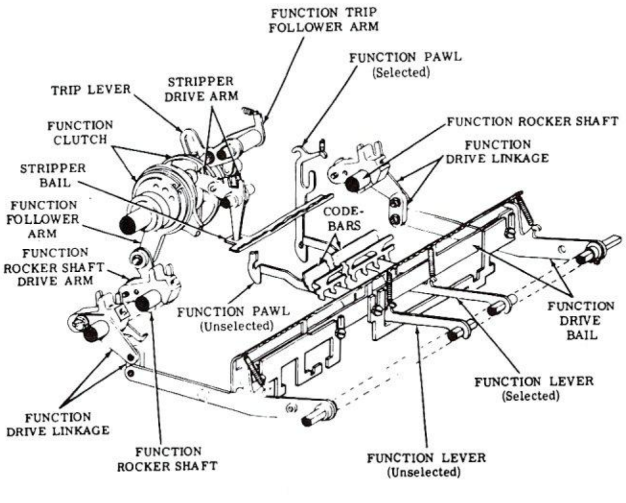


Teleprinter Maintenance Repair-Preventative Maintenance

by Cliff Sparks



(Left Front View)

FIGURE 1. Function Mechanism

This is the fifth article in a series designed to supply the reader with a working knowledge of the Model 33ASR Teletype machine. We gratefully acknowledge the TELETYPE CORPORATION, 5555 Touhy Ave., Skokie, Illinois. Without their cooperation these articles would have been difficult to write.

The fourth article covered the operation of the Main Shaft and Selector Assembly. This article will introduce the reader to the Codebar basket, function pawls, function levers, spacing and suppression mechanisms.

If a character has been introduced into the system by the manual operation of the keyboard, the distributor clutch will have engaged (tripped) and the following events will have occurred:

a) Spacing pulse will be sent to the selector magnet. This will start the selector cycle.

b) Codebar follower arm will be tripped by the now rotating selector cam, that will in turn trip the codebar clutch.

c) The tripped codebar clutch will allow its caming surface to rotate and:

1. First cam will tilt the codebar reset lever, that will rock the codebar reset bail. The rocking motion will allow the codebars in the codebar basket to move upward and to their left.

2. The second caming surface will allow the function clutch trip lever to be activated.

d) The now rotating function clutch will cause it's cam to rotate.

1. The first caming surface causes the stripper drive arm to rock the stripper bail. (Stripper bail strips function pawls from their function levers after they have performed their function.)

2. The second caming surface drives the function rocker shaft and the print suppression mechanism.

Figure 1 shows us the function clutch and its drive mechanisms. The clockwise rotation of the function clutch will cause caming surfaces to transmit a rocking motion to the function rocker shaft, and to the function drive linkage. Notice that the function drive bails are pivoted from a long shaft shown on the upper right of the drawing. The shaft extends downward towards the bottom center of the drawing. This shaft is stationary and it provides a pivot point for all of the function levers and of course the drive bails.

Simply then, what we have is a basket like device, open at one end. In our basket we find the function levers hooked to a pivot bar and being rocked up and down during the cycle of operation.

Let us study the drawing in Figure 1. It will reveal that the codebars are positioned atop the moving function levers. You remember that the codebars are now being moved upward and to their left. The purpose of this movement is to allow the codebar tines (comb like device on the bottom of the codebars) to align themselves in such a manner that they form a slot for the function levers to slip upward into. If an incorrect code has been selected then misalignment will occur and the function lever will not be allowed to lift to its most upward point of travel. That function lever may be referred to as a unselected function lever.

A selected function lever will have been allowed to lift upward and engage with its associated function pawl. Once engagement has been accomplished a downward movement will cause the selected function pawl to trigger either an electrical or mechanical action. The main purpose in movement of these function pawls is to create some function such as line feed, carriage return, bell, space, etc. It is important to the reader to understand that the rocking motion of the function mechanism and the selection of the proper codebars allow engagement and disengagement of function pawls.

Figure 2 and Figure 3 (chart) illustrate all of the possible function levers that may be installed on the model 33ASR. It must be understood that not all of these functions are required to operate your machine, but certainally the minimum requirements would include the carriage return, line feed, space, bell and print suppression.

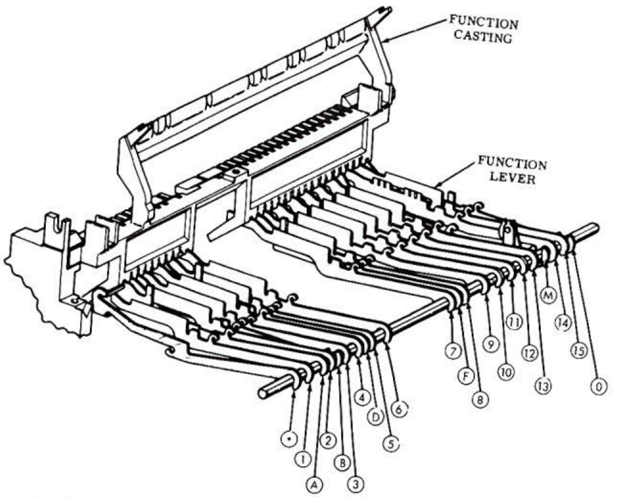


FIGURE 2. Function Lever Code Arrangement

At this point we have our clutches engaged, shaft rotating, codebars lifting toward the left, and our selector mechanism is setting up a selected code. The selected code in the selector mechanism will cause the selector blocking levers to lift upward. Those blocking levers not selected will remain in a horizontial position and block further movement of the codebar. Blocked codebars create spacing action, whereas unblocked codebars mark. Electrically speaking, marking and spacing pulses are found only on contact blocks or within the selector magnet assembly, so let me stretch a point, bend a rule so to speak, and say that any mechanical action that causes a spring loaded device to trip will most likely cause it to trip to a marking position.

CHART

FUNCTION LEVER CODE ARRANGEMENT

SLOTS	FRICTION FEED	SPROCKET FEED
* SEE NOTE 2	LINE FEED BLOCKING	
1 SEE NOTE 2	LINE FEED NEW LINE	NEW LINE
A	AUTOMATIC CARRIAGE RETURN NEW LINE	NEW LINE
2	CARRIAGE RETURN NEW LINE	CARRIAGE RETURN NEW LINE
B	CARRIAGE RETURN ACTUATING	CARRIAGE RETURN ACTUATING
3	SPACE	SPACE
4	PRINT SUPPRESSION ON DELETE, DCI, AND NUL	PRINT SUPPRESSION ON DELETE, DCI, AND NUL
5	PRINT SUPPRESSION ON DELETE	PRINT SUPPRESSION ON DELETE
6	PRINT SUPPRESSION ON ALL CONTROL CHARACTERS	PRINT SUPPRESSION ON ALL CONTROL CHARACTERS
7	BELL	BELL
F	MARGIN BELL	MARGIN BELL
8	SO ENQ	SO ENQ
9	SI ACK DC1	SI ACK DC1
10	ACK ENQ EOT ENQ/EOT (See Note 3) DC1 DC2	ACK ENQ/EOT (See Note 3) DC1 DC2
11	DC3 DC4 ACK DC3/DC1 (See Note 3)	DC3 DC4 DC3/DC1 (See Note 3)
12	BELL EOT ETX ENQ	EOT ENQ ETX
13	EOT	LINE FEED
M		LINE FEED STRIP
14	ACK ETX	FORM OUT
15	ANSWERBACK (ENQ)	ANSWERBACK (ENQ)
0	ANSWERBACK BLOCKING	ANSWERBACK BLOCKING

Note 1: Some slots have more than one function lever designation. The particular function lever for these slots depends on the set. Some sets have no function lever in these slots.

Note 2: The function levers in the * and 1 positions do not occupy slots in the function casting. They are guided by slots in brackets. The brackets are illustrated in the appropriate parts sections.

Note 3: The function lever will respond to either code combination and momentarily open a normally closed contact on the function casting.

Abbreviations:

DC1	Reader On
DC2	Punch On
DC3	Reader Off
DC4	Punch Off
SI	Shift In
SO	Shift Off
ACK	Acknowledge
ENQ	Enquire
EOT	End of Transmission
ETX	End of Text
NUL	Null
LF	Line Feed
BEL	Bell

Note 4: This figure is to be used with the function lever arrangement shown in Figure 6.

Note 5: The following slots have no function levers at present: C, D, E, G, H, J, K, L, N.

FIGURE 3.
Function Lever Code Arrangement

Good examples of this Rube Goldburg principle is the movement of codebars, selector blocking levers, contact wires to a contact bar, and many more. The point we want to make is that by counting the codebars in the upward or selected position we can read the ASCII code that has been selected by the selector mechanism. If we selected "U" we would then find that the number 1,3,5, and 7 codebars would be in the selected position, if we stopped the operation of the machine just as the selector blocking levers lifted and codebars slid into position. We would further find the selector blocking levers 1,3,5 and 7 had lifted. Now I know that some fellow is asking himself, why not just look for the letter "U" on the teletype paper. Not such a dumb question after all, but what if we found that the number 5 appeared. A quick scramble for our ASCII code conversion chart would quickly indicate that the number seven bit had malfunctioned.

Lets do a little assuming: The power has been removed from the equipment. The letter "U" has been introduced into the selector mechanism. The print carriage has not malfunctioned.

The equipment may now be hand-powered (simply use your thumb to pull downward on the motor drive gear in a clockwise direction). If the following conditions are met, we can now observe the movement of the selector blocking levers and the codebars:

- if the selector received the correct information (bits 1, 3, 5 and 7 marking) from the keyboard contact block
- if the associated blocking levers respond to the commands of the selector magnet
- if the codebars are free to slide upwards and to their left . . . then we will have the letter "U" printed on our paper, but only if blocking levers 1, 3, 5 and 7 are marking and codebars 1, 3, 5 and 7 are marking. Failure of the individual bits to respond to commands issued from the keyboard contact block could very likely be attributed to dirty keyboard contact wires or block. If the electrical path was good, the trouble could be found in a maladjusted mechanism that impedes movement of the selector blocking levers or the codebars. At this point in our article we are describing only general malfunctions and possible repairs, for the purpose of demonstrating the value of reading the ASCII code within the selector and codebar mechanisms. Let us continue with the failure as described; the fifth bit was failing. If the unit was removed from its base (isolated) and set upon your work bench and you were to mechanically pick the ASCII character "U" from the selector mechanism, hand crank that letter through the equipment and find no errors, then the error would most likely be found on your keyboard contact block, or perhaps on one of the thirty contacts that are electrically connected to the distributor disc. But if you selected the correct character and the selector blocking levers or codebars failed, they would be easily identifiable.

Once again let me justify the purpose of all the assuming we have been making. Isolation of troubles within your Model 33ASR can best be accomplished through breakdown of individual functions. Removal of the keyboard assures the trouble shooter that the keyboard is or is not functioning. Following this train of thought, removal of the print carriage further helps to isolate the cause of troubles. But the trouble shooter finds that this removal and isolation technique can go just so far. Further disassembly of the equipment may cause its malfunction during an operation cycle, thereby defeating the very technique we find so useful.

The following components may be removed from the printer for trouble shooting purposes. CAUTION: DO NOT APPLY POWER. This applies to the tape punch, transmitter, print carriage, platten assembly, and keyboard. With A/C power applied, and the motor running, you may operate the equipment with the tape punch, transmitter, and keyboard removed.

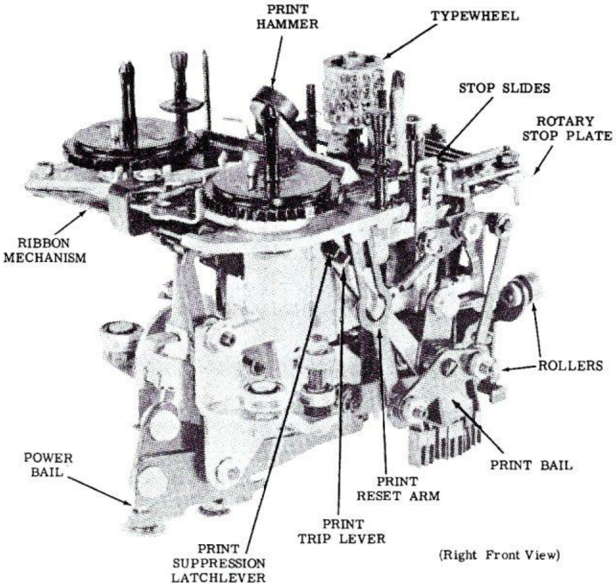

PRINT HAMMER
TYPEWHEEL
STOP SLIDES
ROTARY STOP PLATE
RIBBON MECHANISM
ROLLERS
POWER BAIL
PRINT BAIL
PRINT RESET ARM
PRINT TRIP LEVER
PRINT SUPPRESSION LATCHLEVER
(Right Front View)

FIGURE 4. Print Carriage

Figure 4 shows the print carriage as viewed from the front right, Figure 5 indicates how the print carriage stop slides are riding atop certain codebars. As the codebars are selected they may cause the print carriage stop slides to raise.

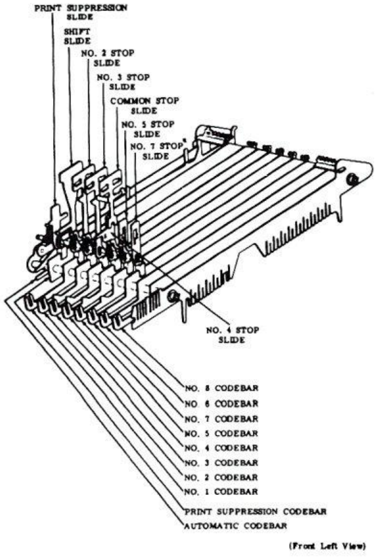

PRINT SUPPRESSION SLIDE
SHIFT SLIDE
NO. 2 STOP SLIDE
NO. 3 STOP SLIDE
COMMON STOP SLIDE
NO. 5 STOP SLIDE
NO. 7 STOP SLIDE
NO. 4 STOP SLIDE
NO. 8 CODEBAR
NO. 6 CODEBAR
NO. 7 CODEBAR
NO. 5 CODEBAR
NO. 4 CODEBAR
NO. 3 CODEBAR
NO. 2 CODEBAR
NO. 1 CODEBAR
PRINT SUPPRESSION CODEBAR
AUTOMATIC CODEBAR
(Front Left View)

FIGURE 5. Codebar Arrangement

Figure 6 shows the rotary positioning mechanism, note how the power for the rotary driver is taken from the rocking movement of the carriage drive bail. The bail is powered by the caming action of the function clutch. Between the bail and the clutch cam there is a long drive arm attached to the drive bail. From Figure 6 it's easy to see that the carriage drive bail motion will drive the right or left rack forward, causing the typewheel to rotate either clockwise or counterclockwise.

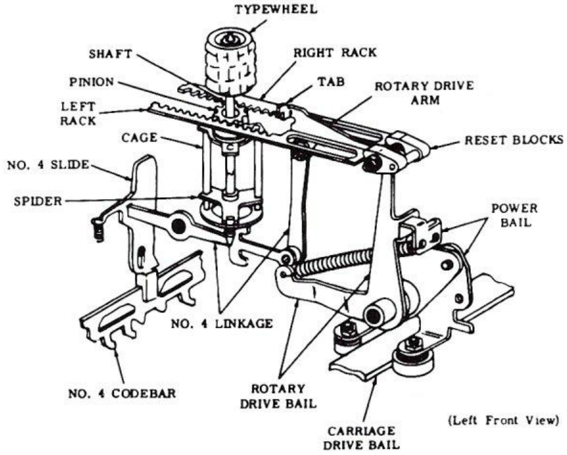

TYPEWHEEL
SHAFT
RIGHT RACK
PINION
TAB
ROTARY DRIVE ARM
LEFT RACK
CAGE
RESET BLOCKS
NO. 4 SLIDE
SPIDER
POWER BAIL
NO. 4 LINKAGE
NO. 4 CODEBAR
ROTARY DRIVE BAIL
CARRIAGE DRIVE BAIL
(Left Front View)

FIGURE 6. Rotary Positioning Mechanism

Figure 7 shows us that if the codebars have lifted the stop slides then one of the racks will move forward (or be driven) through slots cut in the stop slides. Three stop slides are shown in this picture and the rack has penetrated all three. Assume the number 3 codebar was spacing. If this occurred then the rack would not slip through the slots in the stop slides.

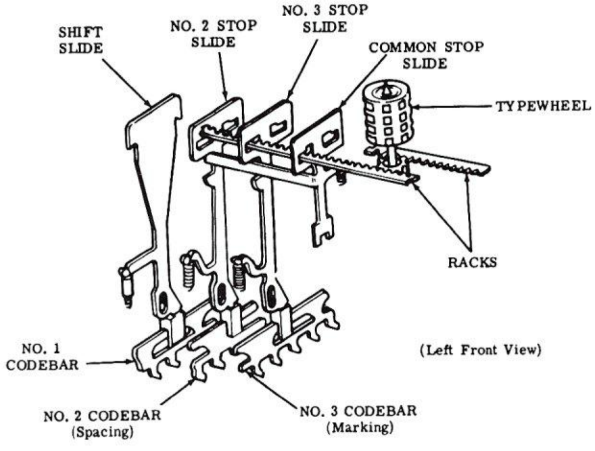

SHIFT SLIDE
NO. 2 STOP SLIDE
NO. 3 STOP SLIDE
COMMON STOP SLIDE
TYPEWHEEL
RACKS
NO. 1 CODEBAR
(Left Front View)
NO. 2 CODEBAR (Spacing)
NO. 3 CODEBAR (Marking)

FIGURE 7. Rotary Positioning Stop Slides

The point we have made here is that the typewheel is a cylinder with type embossed upon its face. Rotation of the wheel either clockwise or counter clockwise will align a selected letter with the face of the paper. Once aligned, a rubber faced hammer strikes the typewheel, embossing the letter onto the paper.

Figure 8 shows the printing mechanism. Figure 9 indicates how the print suppression mechanism is activated. Have you wondered why the teletype machine fails to print during a function.

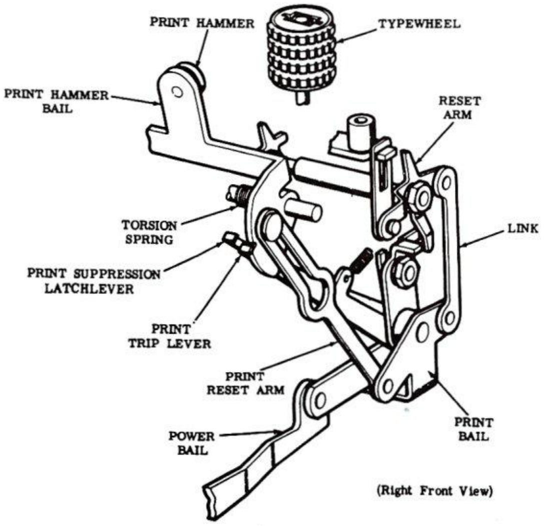

PRINT HAMMER
TYPEWHEEL
PRINT HAMMER BAIL
RESET ARM
TORSION SPRING
LINK
PRINT SUPPRESSION LATCHLEVER
PRINT TRIP LEVER
PRINT RESET ARM
POWER BAIL
PRINT BAIL
(Right Front View)

FIGURE 8. Printing Mechanism

The print suppression latch is activated by the cam, causing the print suppression codebar to latch. This action causes the print suppression slide on the printing unit to lift, tilting the print suppression latchlever. The print hammer bail is inactivated and printing cannot occur.

We will discuss the operation of the print unit in great detail in the next article. ◻

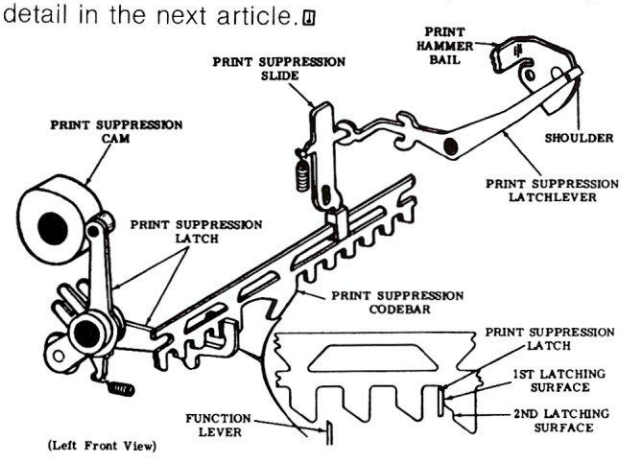
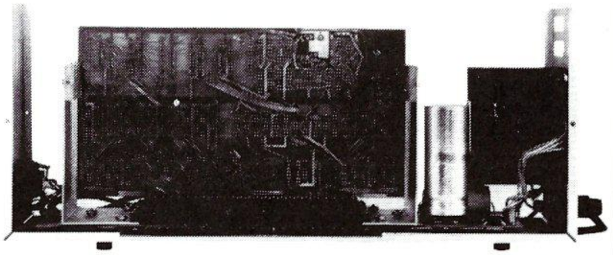

PRINT HAMMER BAIL
PRINT SUPPRESSION SLIDE
PRINT SUPPRESSION CAM
SHOULDER
PRINT SUPPRESSION LATCHLEVER
PRINT SUPPRESSION LATCH
PRINT SUPPRESSION CODEBAR
PRINT SUPPRESSION LATCH
1ST LATCHING SURFACE
2ND LATCHING SURFACE
FUNCTION LEVER
(Left Front View)

FIGURE 9. Print Suppression Mechanism

Introducing The
MICRO-ALTAIR



The complete Computer System that requires just a keyboard and TV monitor for use.

The MICRO-ALTAIR is:

The hardware — video terminal interface board, CPU/ROM/RAM board, backplane, power supply and cabinet;

The software — video driver, debugger, operating kernel supplied on ROM;

The personal computer system — complete, expandable, no loose ends — a complete and powerful tool;

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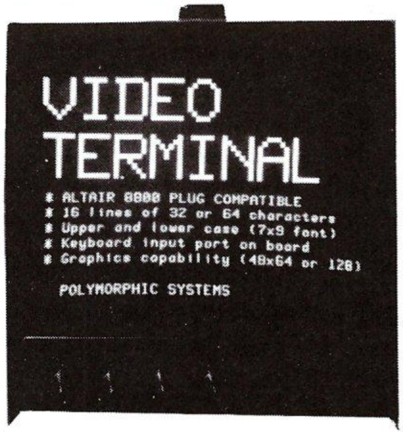
COMPLETE SYSTEM [EXCEPT FOR MONITOR AND ASCII KEYBOARD] $575.00 KIT. DELIVERY 60 DAYS — SERIAL I/O AND CASSETTE OPTIONS AVAILABLE.


VIDEO
TERMINAL
* ALTAIR 8800 PLUG COMPATIBLE
* 16 lines of 32 or 64 characters
* Upper and lower case (7x9 font)
* Keyboard input port on board
* Graphics capability (48x64 or 128)
POLYMORPHIC SYSTEMS

Go to your local computer store and compare

Video Terminal Interface — characters are stored in on-board memory. Entire screen may be read or written in 20 milliseconds. Software includes a text editing system with scrolling and insert and delete by character or line.

VTI/32	32 character line	$160.00 kit	$230.00 assd.
VTI/64	64 character line	$185.00 kit	$260.00 assd.
VTI/SK	Socket kit for VTI kit	$ 15.00	

Delivery — 30 days

Analog Interface — 1 or 2 channels of analog output with 10 bits of resolutions (0-10V or ±5V with bipolar option), 6 bits of latched digital output and 8 analog comparators for software controlled A/D conversions.

ADA/1	1 analog output	$135.00 kit	$175.00 assd.
ADA/2	2 analog outputs	$185.00 kit	$235.00 assd.
ADA/SK	Socket kit for ADA kit	$ 10.00	

Delivery — 30 days

All prices and specifications subject to change without notice. Prices are USA only. Calif. residents add 6% sales tax. Add 5% shipping, handling, and insurance.

POLYMORPHIC SYSTEMS

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AltairAlterations

Single Step Pulser

by John Borders, as told to Mort Stieglitz

Most computers, including the Altair 8080, provide a single-step switch that allows the user to step through their program one instruction at a time for debugging software or to support some manual function. This article, contributed by John Borders, describes a circuit that you can add to your Altair for $2 that will free your hand from the SINGLE STEP/EXAMINE NEXT switch and provide a 1 to 10 Hz single-step function.

You may have had to single step through several hundred or more program steps, or examine next through several thousand or more memory locations trying to find a bug in your computer program. You say that it wasn't fun? That MITS won't replace worn out switches under warranty? That your family doctor can't understand the wierd callouses twixt your thumb and forefinger?

You obviously need an aux for your Altair. This circuit converts one of your aux switches to a slow rate single step/examine next switch for under $2. The circuit is enabled when the CPU is not running (i.e., when the run/stop switch has been stopped) and works by applying a slow rate pulse to either the single step one shot or the examine next one shot (both of which are located on the D/C board), depending on whether the aux switch is up or down. The rate can be adjusted by changing R and C. I have found 5 Hz to the optimum for me. However, people who are more or less proficient in absorbing data may want to use higher or lower rates.

RATE	C	R
1 HZ	100 UF	18 KOHM
5 HZ	10 UF	33 KOHM
10 HZ	10 UF	18 KOHM

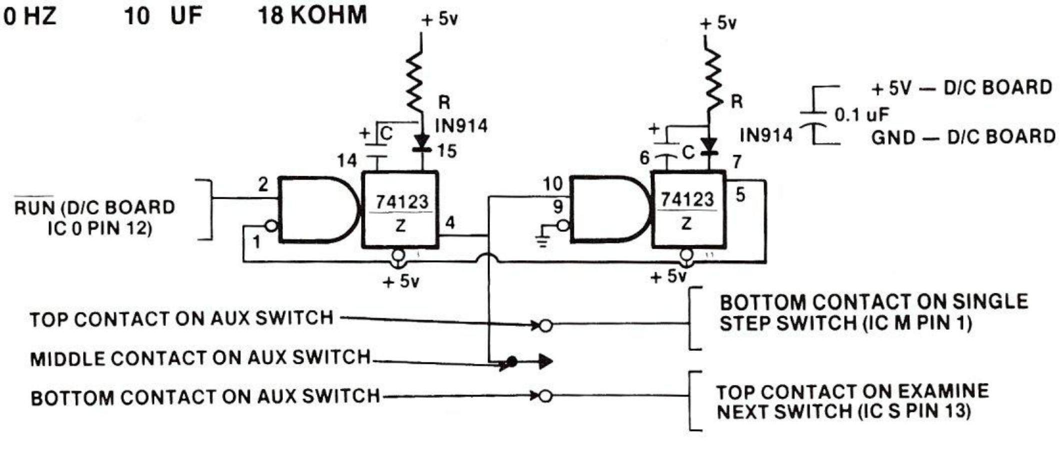

+5v
R
IN914
+ C
14
15
2
1
74123
Z
4
RUN (D/C BOARD IC O PIN 12)
+5v
+5v
R
IN914
+ C
6
7
10
9
74123
Z
5
+5v
+5V — D/C BOARD
0.1 uF
GND — D/C BOARD
TOP CONTACT ON AUX SWITCH
MIDDLE CONTACT ON AUX SWITCH
BOTTOM CONTACT ON AUX SWITCH
BOTTOM CONTACT ON SINGLE STEP SWITCH (IC M PIN 1)
TOP CONTACT ON EXAMINE NEXT SWITCH (IC S PIN 13)

FIGURE 1. Single-Step Pulse Circuit

CONSTRUCTION DETAILS

The single step pulser is installed on the mother board nearest the front panel and wired to a spare auxiliary switch. Figure 2 shows a perspective of the pulser installation. The white wire on the D/C board is part of the AUX modification.

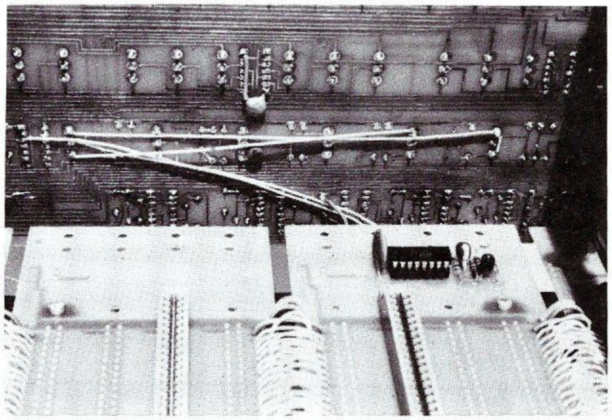


FIGURE 2. Altair Single Step Pulser Installation

Figure 3 shows the pulse circuit mounted on the mother board. Circuit Stiks are applied to the mother board and mounting holes drilled using a #56 drill. Users of Circuit Stik™ should be careful to clean all corrosion (a pencil eraser does the job) and to avoid solder bridges between adjacent pads.

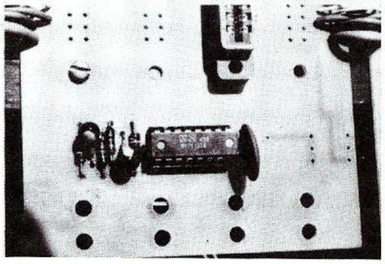


FIGURE 3. Component Locations

Figure 4 shows the external wiring between components and the D/C board while figure 5 shows the wiring between the pulse circuit, AUX switch, and IC M and S.

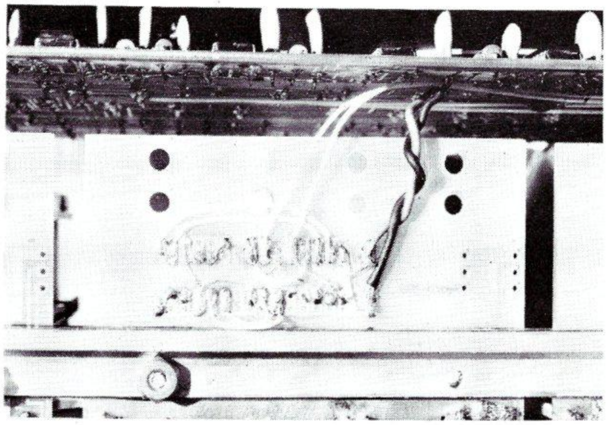


FIGURE 4. Pulse Circuit Wiring

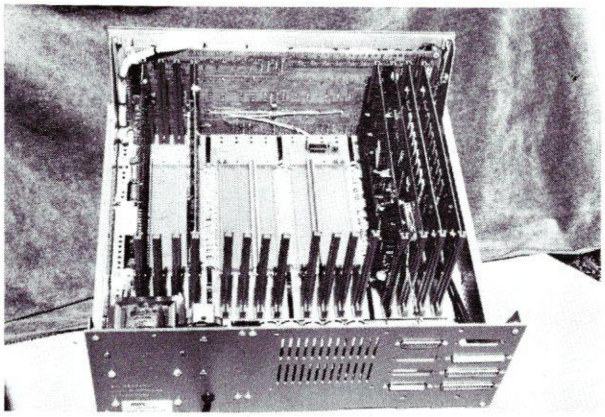


FIGURE 5. D/C Board Wiring

COMPONENTS

1. Circuit Stiks™
2. 74123 dual retriggerable monostable multivibrator
3. 74123 socket
4. 0.1 ufd. capacitor
5. 100 ufd. 18K ohms (1 Hz)
   10 ufd. 33K ohms (5 Hz)
   10 ufd. 18K ohms (10 Hz)
6. Hook-up wire

APPLICATIONS EXCHANGE

(Continued from Page 8)

at our local junior college doesn't get to take courses in digital logic and microprocessors until he has gone through a serial sequence of: Mathematics   DC Circuits   AC Circuits   Solid State Devices. This is in contrast to the parallel strategy of working from broad concepts in all of these areas at once and refining them on subsequent "passes" over the material. I like the latter approach because it is quicker and it enables me to identify and concentrate on topics which are relevant to my personal interests.

BYTE is of course another periodical of great value; however, most of the articles are non-tutorial and must be read with the same expectation—get the big picture now and have faith that the details will clear up in the future.

Two other books must be mentioned: Don Lancaster's TTL COOKBOOK ($9) and THE BUGBOOKS written by Peter Rony, David Larsen and Jonathan Titus. These are *fantastic;* however, I would not recommend trying to read them seriously until you have gotten some hands-on experience with an IC "chip" or two. Therefore, why don't you get copies of the Radio Shack books I mentioned and convince yourself that Ohm's Law is really true. Next month, I'll let you know how I got to playing around with some of the IC chips I'd read about in Browning's *The Best Logic Yet.*

For others who are treading the same path, I'd like to hear from you. Let me know what materials and experiences have been of value to you—I would particularly like references to good tutorial material on electronic construction technique.

UP DATE

(Continued from Page 6)

CASSETTE

Space is still open in the Cassette Design and Construction class.

8080 ASSEMBLY LANGUAGE

Art Childs, at this writing, has planned an 8080 assembly language programming class beginning March 9th for 8 weeks. If interest is sufficient, the 8080 class will be repeated, a 6800 class will be offered and possibly an advanced assembly language class will form, with emphasis on writing supporting software. This will include loaders, debug routines, drivers, and perhaps operating systems. For more information, contact Art Childs, 335 N. Adams, #210, Glendale, Ca. 91206.

TO ENROLL

For classes other than Bruce's, send tuition checks payable to SCCS, c/o Larry Press, 128 Park Place, Venice, Ca. 90291. Your check will not be cashed until the class meets its enrollment goal and is definitely set. Remember that scholarships are available. We would also like to hear from you if you know of places other than the Harvard School where we could hold classes. As stated above, we are still looking for a classroom in the West Los Angeles or Culver City area.

Letters to the Editor

The editor of INTERFACE Magazine wants to know how YOU feel, what YOU think, and respond to your suggestions and requests. Write Editor, INTERFACE Magazine, 335 N. Adams St., Suite 210, Glendale, Calif. 91206.

To Ward Spaniol, President, SCCS

Dear Ward: Thank you for your excellent reply to my editorial (BYTE, February, 1976). It will be printed in full in April BYTE.

Unless I read things incorrectly, my conclusions in the editorial of February are probably well founded. This might even be true if you people at SCCS have not verbalized your intentions. What, with a professional magazine which could develop into the QST of the field, you're miles ahead of any other club.

However, you could pass on to a larger organizational framework if you wanted, and do what Hal Lashlee wants in keeping things local. One possible vehicle for getting a broader geographical distribution would be through the MITS Convention, and also through the convention that John Dilks (Rte 1 Box 242, Mays Landing, NJ 08330) is organizing next fall with his local radio clubs. He wants to have a big convention for radio and computer hackers, sounds extremely enthusiastic on the phone and is currently setting his sights on regional levels. I mention this in passing because by spreading the word around and getting representation from various clubs this could turn into an organizational meeting for a formal national society.

Carl Helmers
Editor, BYTE

Mr. Helmers' letter refers to the growing controversy about the SCCS name, and hence its intentions appearing to be in conflict with its national scope. Anyone interested in either adding to the controversy or offering possible solutions are invited to do so.

Editor

Dear Editor:

Please send me the SCCS INTERFACE. I find the INTERFACE valuable, mostly for its tutorials and construction plans, and also for the comments on commercial units.

Bob Wallace
Seattle, Wash.

*****

I wish to enroll in the SCCS. If the articles in Vol. 1, Issue 1 are any example of the SCCS's work (along with the membership benefits) I will be a member for life. I purchased your magazine at I.C. Electronics, Northridge and haven't been without it yet except for sleeping. This first issue has been jam packed with good information and well worth the cost. Keep up the good work.

Tom Foster
N. Hollywood, Ca.

*****

I am acting as program librarian of the Amateur Computer Group of New Jersey, and as such, I would like to exchange programs, ideas, etc. regarding software, its storage, filing, etc.

Thomas J. Kirk
3 Drake Road
Sumerset, NJ 08873

*****

I had access to your December issue of INTERFACE recently and it looks great. Keep up the good work. One of the articles talked about a FORTRAN version of Star Trek. Are you making a copy of the listing available to club members? Or are you going to put it into future issues of INTERFACE? I am interested in obtaining a copy of the game. If the game was covered in earlier issues, then please tell me how to get copies of articles.

Andrew A. Recupero
San Jose, California

Dear Andrew:

For information on games like Star Trek, write to Mike Stern, P.O. Box 44236, Panorama City, California 91412. He has the FORTRAN version.

Editor

*****

I received my first issue of INTERFACE (February) yesterday, and it was quite impressive. The circuit in Scott Wilcox's article came just at the right time! . . . Well done!

Joseph Mockus
Columbus, Ohio

*****

Dear Editor:

If you have a copy of Ted Nelson's Computer Lib/Dream Machines you can find a description of PLATO on page dm26 and a pic of me on page dm21. I have precipitated a large group of micropeople out of the PLATO pool. I simply started an open newsletter online. Everyone is allowed to read or write articles and reply to articles. As disc space for the newsletter fills the oldest articles are zapped. Our informal club has members in most PLATO locations (i.e., Chicago, Urbana, U of Conn., Cornell U. SIU, etc.). Things are starting to roll. One member got a source editor up and running (executes on PLATO). Another got an assembler of 8080 code going. I set up a simulator of the 8080. Another member set up a lesson (program) that allows one to draw circuit diagrams and catalogs them so other members can see them. The next big project coming up is a series of lessons on the basics of micro-computers and details of 8080/6800 instruction execution. Hopefully this will be a continuing project, expanding to other machines, peripherals and online simulators and assemblers.

Some of us think it would be nice to become a chapter of SCCS. What does it take to become a chapter?

On another subject, I know five people who want to get floppy disc drives, but don't want to pay $1k for them. I wonder if the SCCS is considering a group purchase of discs. I hope you'll consider it as 30cps paper tape is driving me bonkers.

Happy year of the Dragon,

AL9000 (or . . .)
Alan McNeil
Chicago, Illinois

Your revolving newsletter on PLATO sounds innovative and interesting, Alan, and other members will be interested in the details. Would you care to write an article on the project for SCCS INTERFACE?

At this time, to become a chapter is quite simple. You've taken the first step by joining SCCS. The second step would be to have the other interested persons join, let us know the chapter name you choose, and send any chapter news you'd like published in the "Update" section. We will also print the name and address for other interested persons in your area to contact. Your letter is being passed on to the membership chairman who will contact you with further information on chapterizing.

About floppies—we've heard rumors of Diablo coming out with a dual floppy for the $1200 range—but . . . nothing official yet. When a good, reasonably priced floppy comes on the market, group purchase will go to work on it.

Editor

*****

Dear INTERFACE,

After hearing several members express discordant views toward the various hobbyist computer manufacturers business practices and equipment designs, I feel compelled to uphold their efforts and endeavors. Human nature is quick to condemn and slow to praise. The hobbyist computer manufacturers are pioneers in a new and mushrooming field and deserve praise for producing systems economical for individuals.

Without the initial efforts of companies such as MITS we would not be at the point we are today. Granted, there are always things that could have been done better, but the point is that they were done at all is significant. I, personally, don't believe that the various manufacturers are villians, thieves, or mountebank charlatans.

As far as delivery goes, in my engineering years with General Motors I can say that deliveries of components and hardware are always bad for some items. Delivery times (after receipt of order) of 4 to 6 weeks are nothing. Sometimes we wait 4 to 6 months for special and low volume parts. Commercial computer type equipment can also result in long waits. Does anyone disagree?

Prices are another point of contention. We hobbyists are a strange bunch. We want commercial grade equipment at giveaway prices; we want all software to be "public domain"; we want all the information that we can get our hands on, and we want it all *right now!* It is possible for the amateur to get his CPU, 8K of memory, I/O interface, a Teletype, and BASIC language for under 2½ kilobucks. It is a lot for an individual to shell out, but just try to talk DEC out of that package for the same price.

In keeping with the genius intelligence level of the computer nut (who else would think that 'playing' with computers is fun?), I advocate a corresponding level of understanding and tolerance of the problems that this field is fraught with. After all, who should cast the first stone of criticism? I cite the shortcomings of our own group purchase program. Have we acknowledged orders to the group purchaser? Do we have an adequate follow up program to know the status of an individual's order when it did not arrive when expected? What recourse do we have if there is a defect or shortage in the item obtained through group purchase? The manufacturer effectively knows nothing of having sold equipment to us as individuals; he sold to S.C.C.S. Is the warranty to S.C.C.S.? If told of problems will S.C.C.S. then go to bat for us to rectify the situation?

In closing I am looking forward to the upcoming conference in Albuquerque where meaningful exchanges of views and opinions can take place, in addition to the technical overviews, all of which should prove to further the growth of our common field.

S. Wilcox
Alhambra, Ca.

Your point is well put and well received. Thanks Scott for viewing the "other side of the coin."

Editor

*****

Dear Editor:

I am an electronics engineer and am building a microcomputer from the Motorola 6800. I would like to find out if there is a computer club or anyone in the east Detroit area that is interested in starting one. I have been getting the magazine "BYTE" and I feel this is a good start for the computer hobbyist. But clubs are also needed for people to get together and swap or build more complex programs. I would also like any information on standardizations that have been made in the area of data transmission, I/O control, and data storage onto tapes. This information, or someone who I could contact for this information, would be greatly appreciated.

Dennis Siemiet
Utica, MI.

We know of no club in the East Detroit area, however, if you are interested in starting a new chapter, contact Louis G. Fields, 11662 Sunset Blvd., Los Angeles, Ca. 90049. In the meantime we will print your name and address in the "Update" section so that others in your area will know of your interest.

Regarding standards, contact Bill Roch, 5658 Keokuk Ave., Woodland Hills, Ca. 91364. Bill is acting as the temporary communications point for standards until a formal committee is established.

Editor

*****

Dear Editor:

I purchased your magazine (Vol. 1, Issue 2) from a local electronic store and I think it's a fantastic magazine. We have needed this type of information for a long time.

Len Poche'
Garden Grove, Ca.

*****

Reading "Introduction to Microprocessor . . ." in the January INTERFACE has prompted me to join SCCS so I won't miss the following installments.

A. Kitaji
Canoga Park, Ca.

We're pleased to find the intro to microprocessor series valuable. There are other informative articles coming, also.

Editor

*****

Thanks for sending us the information about SCCS's meeting schedule. We just received a copy of the January issue of INTERFACE . . . I must add that the activities and growth of the Southern California Computer Society and INTERFACE are most impressive. You do a terrific job!

Mary Lou Beetle
ON LINE
Los Gatos, Ca.

*****

Many thanks, Mary Lou

Dear Editor:

8008 is UP AND RUNNING

I am now running an 8008 system with about 1K ROM, and resident software of my own design. My tape interface works find with only one IC. I have a PROM programmer, eraser, and a 300 baud printer. I'm now working on a calculating language.

A lot of guys look down on the 8008 but that doesn't bother me too much—it's just a function of when you get into the field. And the effectiveness of a system depends more on development than the CPU (which is why there are a lot of people looking at the Intersil PDP-8 equivalent).

P.S. Do you guys buy *articles?*

Terry F. Ritter
Austin, Texas

Dear Terry:

All of our editorial materials are contributed—we're non-profit with no allocations for payment. If you'd care to share your obvious expertise with other home computerists, we'll be happy to print it and help support the 8008 users.

Editor

*****

I have heard a lot about your club and about what you have done to help the computer hobbyist. As not only a hobbyist with a homebrew 8080 computer, but also an instructor in computers for Compuscan, I feel that I could keep abreast of this quickly changing field with your help. I hope that sometime I may be of service to the club.

Bruce C. Lill
Ho-Ho-Kus, New Jersey

Dear Bruce: Thank you for your endorsement. Yes, you can help by sharing your 8080 knowledge with INTERFACE readers.

Editor

*****

Enclosed please find my membership application and check for $10.00. While I do not expect to be able to attend many meetings, the INTERFACE alone is well worth the price. I wish the society well, and will be glad to be a member.

Stanley S. Veit
Pres., Computer Mart of New York

Dear Mr. Veit: Your enthusiasm is appreciated. Apparently, there are numbers of long-distance members who feel as you do. We're encouraged to know that our publication is effective in achieving SCCS goals of serving the computer hobbyist.

Editor

*****

I have just received my first issue of BYTE Magazine (February) and felt almost obliged to write to you about the possibility of forming a North Jersey computer club/chapter of your organization.

Seeing that you have already established a chapter in the Philadelphia area and that many individuals (myself included) think that a national computer society on the hobbyists' level would be a very decent thing for the progress of computerism both amateurely and professionally, I would appreciate any help that you could supply in trying to form an extension out this way.

Bruce C. Dallard
Dover, NJ

Dear Bruce:

We've taken your proposal seriously and made the same suggestion in "Update," this issue. You'll soon *know just how much interest you've generated by the response you get.*

Editor

*****

It looks like you better add me to your membership list. I bought your magazine today and enjoyed it a lot. I also finished my Altair 680 today but it is not as enjoyable as your magazine is. It doesn't work . . . well the people at the computer store can get it working.

I am a student at Cal State Chico (334 Whitney Hall, Chico, Ca. 95926) and would appreciate it if you would inform me if you have any members at my school.

Michael Spaun

Dear Mike:

We can't help you on who goes to school where, but anyone who reads INTERFACE at Cal State Chico will surely get in touch with you. Good luck with your Altair 680.

Editor

*****

Here in New York we are in the process of organizing the NYC Micro Hobbyist Group and would be interested in getting any suggestions or ideas you might have. We've been looking for a home and as of now it appears that we'll be "affiliating" with the computer science department of Queens College, which has an active microprocessor software and hardware design group. Once we get up to speed we hope that we can contribute to a formal or informal "National Hobbyist Computer Society."

Robert Schwartz
New York

Dear Robert:

It appears that you are headed in the right direction. If you would care to become an SCCS chapter, we'll soon be printing an article containing suggested guidelines for such an endeavor.

Editor

*****

I'm interested in working on formation of a Southern New England chapter. Major interests: newsletters, minimizing hardware through use of software.

Charles A. Floto
267 Willow St., "I"
New Haven, CT 06551

Charles:

Mention of your intent can be found in the "Update" section of this issue.

Editor

*****

WHAT'S THE BEST SYSTEM?

I have just completed reading an article by Robert Sugerman in *Electronic Engineering Times* that mentions your hobby club and activities. As an EE, I too have become interested in microprocessors and their use in TV games such as Computer Space, a computer tank game, Star Trek, etc.

Please advise me in what you consider is the most appropriate hobby type system available and why. My inclination is toward an 8080 or 6800 system. I am also curious if your club has instructions on how to assemble the hardware and software for these types of games. My most immediate problem is understanding how the computer controls the TV display, and to whom one must write to obtain a good course in software instruction. If this requires becoming a member of your group I would be interested in becoming an affiliate.

As I do not know of any clubs of your type in my own area I hope you will respond and help guide me in this endeavor.

G. Bruce Cameron
226 Rue de Maison
Kokomo, Ind. 46901

Dear Bruce:

Of the several micros offered to the home computerist, we would suggest an 8080 based machine at this time because of the availability of software. It's likely that within a few months, a 6800 based machine would be an equally viable alternative as it is rapidly becoming popular and the interest will generate as much, or more software than currently exists for the 8080. We would suggest you contact one of the several manufacturers offering machines designed specifically for the hobbyist, a number of whom are listed in these pages.

To control a TV display, special devices will be necessary except where the manufacturer offers a CRT as part of the system. For a color TV display we suggest you contact Cromemco, One First St., Los Altos, Ca 94022. Or for a black and white TV display we suggest Polymorphic Systems in Goleta, Ca., or Processor Technology in Berkeley, Ca. The Polymorphic Systems' computer, the MICRO-ALTAIR, [trademarked] is a new and interesting concept in that it allows building your machine in a modular fashion—expanding in size as you go—but gives you a workable microprocessor with the first module at minimum cost.

Software to support the video display is usually available through the manufacturer of the display board. Software for games is available from SCCS members who have an interest in the application, and you may get to the point where you'll be writing your own. Basic is usually the language used and is less difficult to learn than most people believe.

As an SCCS member you may utilize the free member ad priviledge to request specific software and collect your own library. In a surprisingly short time, you'll find yourself in a position to give the same assistance to other new members. The opportunity to participate in group purchase is another benefit to members. This ususally results in a 10% to 15% reduction in cost of many components.

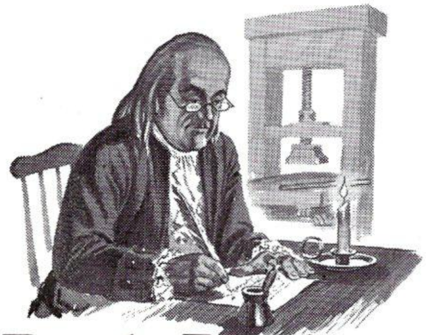
Future issues of INTERFACE will feature articles that will aid the club member in becoming a proficient home computerist programmer, and will deal with Assembly Language and Basic. There are several good books on Basic including games written in Basic and

LETTERS TO THE EDITOR (Cont'd)

we recommend you begin with "What Do You Do After You Hit Return," available from People's Computer Company, P.O. Box 310, Menlo Park, Ca. 94025.

Your interest in forming a club may attract readers in your neighborhood who are equally interested in formalizing an association, or a chapter of SCCS. Good luck and welcome to our crazy world.

Editor



Book Review

"PRINCIPLES OF INTERACTIVE COMPUTER GRAPHICS"
by William M. Newman and Robert F. Sproull
McGraw-Hill
Price: $18.50

This text is concise, well written, easy to understand and will suit the needs of the amateur and professional who wishes to learn about computer graphics. It is divided into five major sections which discuss: Display Hardware; Graphic Output; Graphic Input; Three Dimensional Graphics and Graphic Systems. Additional understanding of computer graphics is easily gained as the text details time-shared graphic systems, surveys higher level languages, command languages, the design of interactive dialogues, shading three-dimensional transformations and perspective, vector generation and much more. Since this graphics book is written so that it is independent of machine language, it won't write your program for you, but it will help you avoid writing programs that don't work.

This text is an excellent addition to the library of the computer graphics enthusiast or professional.

Unclassified Advertising.....

Caveat Emptor

MEMBERSHIP CLASSIFIED ADVERTISING

Each month SCCS Interface will devote some space free, non-commercial advertising by members. This is done as a service to members of the Southern California Computer Society and to help promote communications between computer experimenters and hobbyists throughout the world.

Many SCCS members, being pioneers in the small computer field, often have for sale, on an occasional basis, used computing equipment, or equipment they have designed and built themselves. Those members, as well as those who simply wish to establish contact with individuals with similar or complimentary interests are encouraged to utilize the member ad privilege subject to the following conditions:

A. Ads must be received by the ad editor of SCCS Interface by the first of the month prior to issue month

B. Ads may list the member's name, home address and phone. No commercial firm names, please!

C. Ads must be typewritten, double spaced and no more than 250 characters (including spaces and punctuation) in length. Ads 250-500 characters will be printed on space-available basis.

D. Ads may be run up to three consecutive issues, however, a specific request must be received for each instance.

E. No free member ads will be accepted for the sale of equipment or services by a commercial profit-oriented individual or organization.

Address all member ads to: Interface Ad Editor, Nancy DeLong, 8005 Denrock Ave., Los Angeles, Calif. 90045

Those non-members wishing to advertise are invited to join SCCS and enjoy the member ad privilege as well as the delivery of SCCS INTERFACE to your mail box.

MICROSYSTEM CONSULTANT for your special requirements for systems or hardware design. Ruben Loshak, 4040 Badillo Circle, Apt. 50, Baldwin Park, Calif. 91706. (213) 338-8549.

WANTED: R-R tape recorder with slow speed, portable, for recording meetings. UHER or other. Also, pin feed TTY gummed labels. Louis Fields, 11662 Sunset Blvd. Suite 2, Los Angeles, Ca. 90049 [213] 472-0383

FOR SALE: KENNEDY Model 2869 9 TR, 800 BPI, Tape Drive. Has read/write capability at 15 IPS with 12 KB/SEC data transfer rate. Lists for $3,100.00 will sacrifice almost new for $2,100.00. Contact E. Wodrich at (213) 683-1560 Ext. 168. 9 AM-5 PM or (714) 622-9952 evenings.

FOR SALE Singer-Friden terminal, perfect for µp's. 100 WPM printer. 10 CPS [8 channel] reader and punch. Uses paper tape or edge punched cards. $425 each. Bruce Adams (714) 792-9531.

FOR SALE - MAYBE: Anyone interested in used hardcopy terminals (Syner Data Beta or Topograph) at $500-$600, call and leave phone no. or address. If we can get them we will let you know. ASCII Code, 10-15-30 cps, RS23C Interface, 132 column, adjustable with tractor, use back side of used printouts for your paper supply. Bill Kelly (213)379-2786.

Handsome engraved membership badges for members, officials and officers. $3.50. Help people know who you are. Contact Louis G. Fields, membership Chairman, 11662 Sunset Blvd., Suite 2, Los Angeles, Ca. 90049. Call (213) 472-0388 or (213) 272-0942.

HAMS & CB'RS Please contact SCCS VP Louis G. Fields, 11662 Sunset Blvd., Suite 2, Los Angeles 90049 (213) 472-0388 or (213) 272-0942.

Save my marriage! Buy my new assembled IMSAI 8080, Loaded 22 slot mother board, 8k Ram, regular price, $1835.00. Will sell to highest bidder above $1700.00. Also, IMSAI 8080 kit, still in box, large mother board, regular price $587.00. Will sell to highest bidder above $547.00. Send bids to 664 Via Alamo/San Lorenzo, Ca. 94580

ARTIST WANTS HELP. I would like to find information and people involved with numerical controlled machinery for applications to computer-generated graphic art and sculpture. Tom Woodward. 1415 Second St., Santa Monica, Calif. 90401. (213) 451-8774.

ATTENTION MIKE OWNERS! MIKE Information Packet No. 1 contains over 100 pages of hardware design and software listings including interfaces, count-down circuit, push/pop stack, and swap registers plus over 50 pages of software listings. Much of this information can be used on any 8008 based system. Please send a $5 check to Jim Farschon, 3949 Mt. Everest Blvd., San Diego, Calif. 92111—(714) 292-9180.

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SCCS MEMBERSHIP NUMBER

Do you need to know your membership number? Perhaps you did know, but forgot it. You can find it — and be reminded each month — by looking on the SCCS INTERFACE mailing label.

INTERFACE BACK ISSUES

A limited quantity of December, January and February issues are available from the publisher. $1.75 per copy plus 50¢ for handling and postage.

Send Cash, Check or Moneyorder to:

McPheters, Wolfe & Jones
INTERFACE—BI
P.O. Box 1234
Cerritos, CA. 90701

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Group Purchase For SCCS Members

A group purchase program has been established to enable all SCCS members to participate in the buying of selected products at discounted rates. To find out products and prices, a taped telephone message is prepared monthly, (213) 425-5120, with updated information. The tape states the date of the recording so callers can verify that they have current data. Announcements of available products will be made at each SCCS monthly meeting, and the tape is then updated. But please allow three days after the meeting for preparation of the new message before calling.

Since the message is stated only once and very quickly, it is suggested that a cassette recorder be used to make a permanent record of the information. The message will mention the product name and price only. For complete details on products listed, refer directly to the manufacturer or product vendor.

ORDER DEADLINE IS THE FIFTH OF EVERY MONTH. Orders received on the fifth of the month prior to meeting date will be delivered at the meeting. Group purchase is based upon quantity requirement—if the minimum is not met, either a refund of your money, or holdover of delivery until the following month, may be required. Those who wish to receive shipment by UPS must add 5% to their purchase price to cover shipping and insurance. A 2% add-on (or $1, whichever is greater) is required to cover handling costs. California residents must add 6% sales tax to the total purchase price.

Send your check or money order, made out to the Southern California Computer Society Trust A, along with the order form below.

GROUP PURCHASE ORDER FORM

Clip and mail this order form, with your check or money order, to

SOUTHERN CALIFORNIA COMPUTER SOCIETY
3238 Faust Street
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I will pick up my order at the next SCCS meeting ☐

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I can't make it into one of your stores so please RUSH me a copy of the **Microcomputer Dictionary.** If payment accompanies order I.C. will pay for shipping. (That's nice.) California customers add 6% sales tax.

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12

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This page is presented for the convenience of both reader and advertiser so important articles may remain intact.

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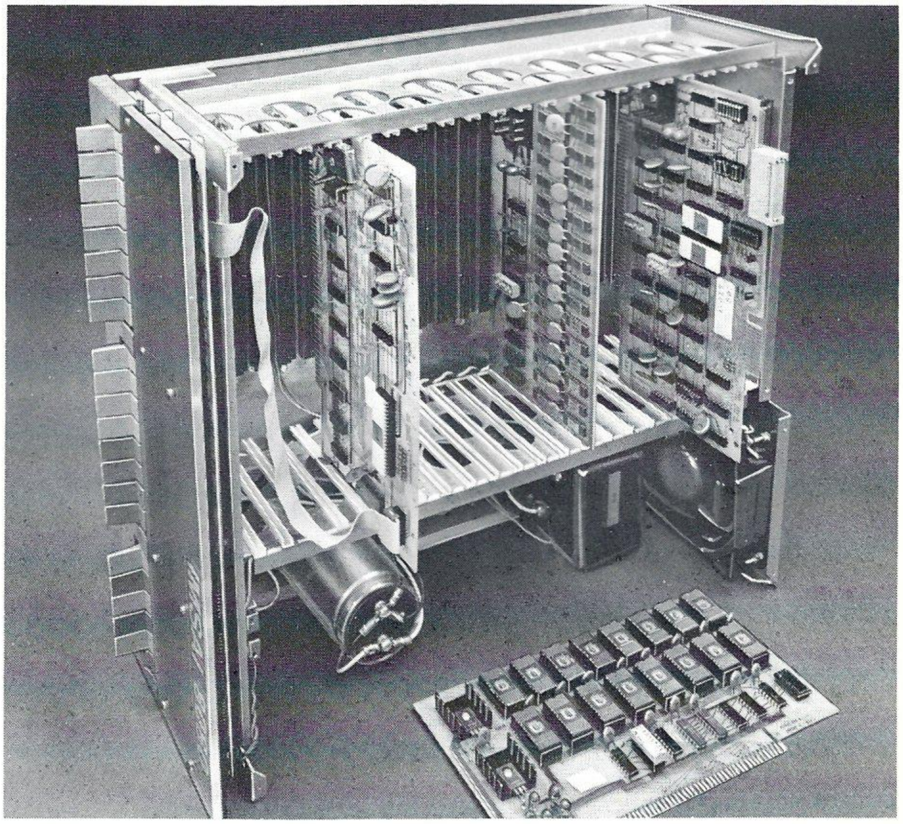
If you thought a rugged, professional yet affordable computer didn't exist,

think IMSAI 8080.



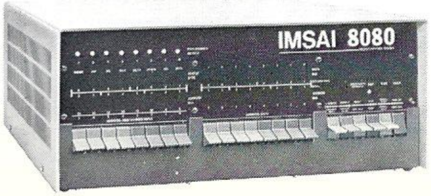
Sure there are other commercial, high-quality computers that can perform like the 8080. But their prices are 5 times as high. There is a rugged, reliable, industrial computer, with high commercial-type performance. And prices that are competitive with Altair's hobbyist kit. The IMSAI 8080. Fully assembled, it's $931. Unassembled, it's $499, until May 1–then $599. And ours is available now.

In our case, you can tell a computer by its cabinet. The IMSAI 8080 is made for commercial users. And it looks it. Inside and out! The cabinet is attractive, heavy-gauge aluminum. The heavy-duty lucite front panel has an extra 8 program controlled LED's. It plugs directly into the Mother Board without a wire harness. And rugged commercial grade paddle switches that are backed up by reliable debouncing circuits. But higher aesthetics on the outside is only the beginning. The guts of the IMSAI 8080 is where its true beauty lies.

The 8080 is optionally expandable to a substantial system with 22 card slots in a single printed circuit board. And the durable card cage is made of commercial-grade anodized aluminum. The Altair kit only provides 16 slots maximum in four separate sections, each section requiring 200 solder connections.

The IMSAI 8080 power supply produces a true 20 amp current, enough to power a full system. The Altair produces only 8 amps.

You can expand to a powerful system with 64K of memory, plus a floppy disk controller, with its own on board 8080–and a DOS. An audio tape cassette input device, a printer, plus a video terminal and a teleprinter. These peripherals will function with an 8-level priority interrupt system. IMSAI BASIC software is available in 4K, 8K and 12K, that you can get in PROM. And a new $139 4K RAM board with software memory protect.



Find out more about the computer you thought didn't exist. Get a complete illustrated brochure describing the IMSAI 8080, options, peripherals, software, prices and specifications. Send one dollar to cover handling to IMS. The IMSAI 8080. From the same technology that developed the HYPERCUBE Computer architecture and Intelligent Disk systems.

Dealer inquiries invited.

IMS

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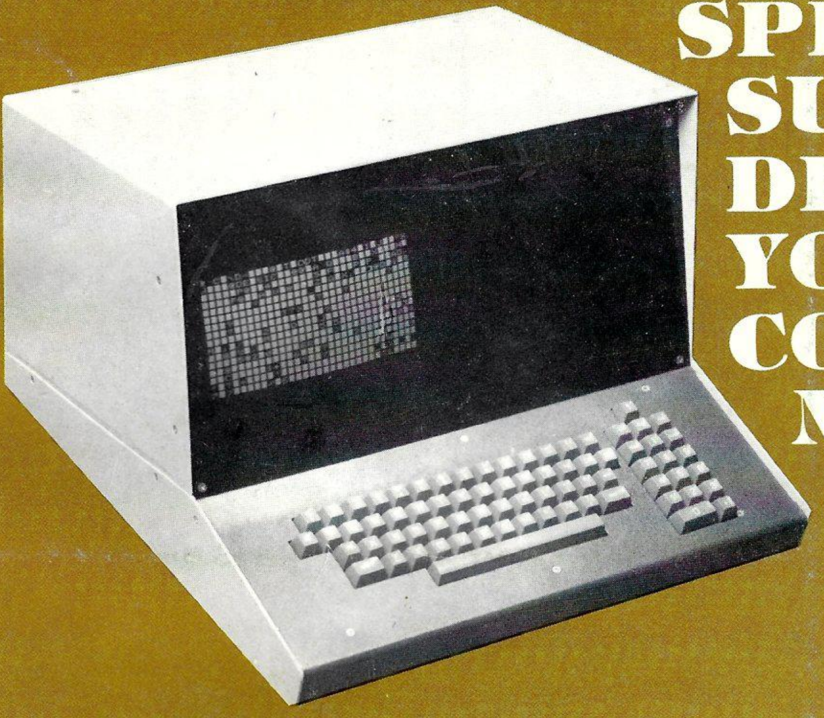

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After talking to thousands of potential and existing computer users like you, we have found that what you want is a computer that has these features:

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- **INPUT/OUTPUT** (serial and Parallel) for communication with **the outside real-world devices** such as printers, teletypes, telephones, security devices, security monitoring, etc.

These same people say they like a SPHERE COMPUTER SYSTEM because of the **complete COMPUTING POWER** that the **SYSTEM** has to offer.

The advantage of a SPHERE SYSTEM is that in ONE package you can get all the fundamental Computer Features that will allow you to input your programs through the keyboard, process your information, and produce meaningful output.

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We have at SPHERE even more options for even greater computing power. See the price list for the details.

As we were conversing with you we found that there are about four general categories of computer users. The categories and the SPHERE SYSTEMS developed to accommodate them are the following:

KIT BUILDER: SPHERE SYSTEM 310: you are the one who wants to put a computer together to learn all about it and save some money too.

HOBBIEST: SPHERE SYSTEM 320: the one who wants a spare time challenge with ample programming power to do fun, constructive things.

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